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TECHNICAL ASSESSMENT OF THE RESERVE COMPONENT AUTOMATION SYSTEM (RCAS) AND THE JOINT COMPUTER AIDED ACQUISITION AND LOGISTICS SYSTEM (JCALS)

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RCAS and JCALS are large DoD initiatives that will provide automated information system and communications capabilities for their respective communities. This report documents the results of a technical assessment of the suitability of using the RCAS and JCALS systems architectures and user interface methodologies as a standard in other DoD functional areas. The report concludes that there are significant features provided by the two programs that may be applicable to other DoD functional areas. The open systems standards-based system architectures of the two programs can serve as models for future systems architectures.

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EXECUTIVE SUMMARY

The Reserve Component Automation System (RCAS) and Joint Computer Aided Acquisition and Logistics System (JCALS) programs are large Department of Defense (DoD) initiatives that will provide automated information system (AIS) and communications capabilities for their respective communities. They are expected to realize significant Government cost savings and avoidances. This report documents the results of a technical assessment of the suitability of using the RCAS and JCALS systems architectures and user interface methodologies as a standard in other DoD functional areas.

The RCAS and JCALS system architectures were determined to be well-founded and comprehensive open systems, standards-based architectural models that are compliant with DoD goals, guidelines, and directives. The two programs have several architectural and technological similarities. For example, diskless X-Windows-based terminals are slated for use as the primary end user workstation, and similar suites of office automation applications will be provided for both programs. Further, POSIX-compliant UNIX operating systems will be implemented on server platforms for both programs.

Client-server architecture-based applications will be implemented for both programs in various forms. Examples include: the remote presentation client-server model, which is the foundation for the X-Windows-based terminal devices; and the development of applications that use UNIX pipes or sockets, which are client-server-based communications processes. RCAS and JCALS use the same X-Window System and OSF/MOTIF-based graphical user interface (GUI). The GUI is an integral part of the user's view of the two programs and will alleviate the need for each user to become proficient in the use of the operating systems.

Both program system architectures are designed to facilitate interconnectivity between a large number of remote facilities. Similarly, the two programs will make extensive use of LAN technologies at the program sites. The RCAS program will use Ethernet-based LANs, while the JCALS program will implement FDDI-based LANs.

While the RCAS and JCALS programs have conceptual similarities, different hardware and software platforms and products have been selected for the initial implementation of each program.

In conclusion, there are significant features provided by the two programs that may be applicable to other DoD functional areas. The open systems, standards-based system architectures of the two programs can serve as models for future system architectures. The RCAS program includes a set of forms-based Ada applications to automate the completion and processing of DoD standard forms. Finally, the JCALS program is developing a sophisticated Global Data Management System that will enable JCALS data to be implemented in physically distributed data bases.

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SECTION 1. INTRODUCTION

1.1 Purpose of the Technical Report

This report assesses the suitability of using the Reserve Component Automation System (RCAS) and Joint Computer Aided Acquisition and Logistics System (JCALS) systems architectures and user interface methodologies as a standard in other functional areas. It evaluates the programs. This report was developed in response to requests from the Office of the Assistant Secretary of Defense (OASD) for Command, Control, Communications, and Intelligence (C^3I).

This report documents the methodology used in evaluating the client-server architectural and user interface approaches used by the RCAS and JCALS programs. Additionally, an analysis of the RCAS Economic Analysis Report (EAR) is included.

1.2 Scope of the Document

The sections included in this analysis report are summarized below:

- Section 1, Introduction, presents the purpose of the report, briefly describes each section within the document, identifies project references used in the preparation of this report, and defines terms and abbreviations used throughout the document.

- Section 2, Background, introduces client-server and user interface technologies, and discusses the hardware and software components and communication technologies available from the RCAS and JCALS programs.

- Section 3, Evaluation Methodology, discusses the techniques and procedures used in evaluating the client-server architectural and user interface approaches employed by the RCAS and JCALS programs.

- Sections 4, Conclusions, summarizes the results of RCAS and JCALS evaluation efforts. It presents conclusions on the suitability of using RCAS as a standard for client-server architecture and user interface methodologies.

- Appendix A, RCAS Compliance with the DoD Technical Reference Model (TRM) Summary Matrix, depicts the capability of RCAS to satisfy the provisions of the DoD TRM.

- Appendix B, RCAS Compliance with the DoD Human Computer Interface (HCI) Style Guide Summary Matrix, depicts the capability of RCAS to satisfy DoD user interface methodology requirements.

- o Appendix C, JCALS Compliance with the DoD Technical Reference Model (TRM) Summary Matrix, depicts the capability of JCALS to satisfy the provisions of the DoD TRM.

- o Appendix D, JCALS Compliance with the DoD Human Computer Interface (HCI) Style Guide Summary Matrix, depicts the capability of JCALS to satisfy DoD user interface methodology requirements.

1.3 Project References

The following documents were referenced during the development of this technical rep :

a. Demonstration of the Reserve Component Automation System (RCAS), The Boeing Company, 21 September 1992.

b. Human Computer Interface Style Guide, Version 1.0, Defense Information Systems Agency (DISA)/Center for Information Management (CIM), 12 February 1992.

c. MACOM Validation Review of RCAS Economic Analysis Memorandum, Department of the Army, 9 October 1991.

d. Reserve Component Automation System (RCAS) Hardware Subsystem Specification, Revision A, The Boeing Company, 19 June 1992.

e. Reserve Component Automation System (RCAS) System Specification, Revision B, The Boeing Company, 3 August 1992.

f. Reserve Component Automation System (RCAS) System/Subsystem Specification Software Subsystem Specification, Revision B, The Boeing Company, 3 August 1992.

g. Reserve Component Automation System (RCAS) System/Subsystem Specification Telecommunication Subsystem Specification, Revision B, The Boeing Company, 1 April 1992.

h. Reserve Component Automation System (RCAS) Technical Analysis/Cost Estimate Technical Report, Final, The Boeing Company, 7 February 1992.

i. Strategies for Open Systems, Defense Management Review, 1991.

j. Technical Reference Model (TRM) for Information Management, Version 1.3, Defense Information Systems Agency (DISA)/Center for Information Management (CIM), 31 July 1992.

k. Joint Services/DLA Computer Aided Acquisition and Logistic Support (JCALS) System, Software Requirements Specification, Book 1 - Workstation Management CSCIs (1/4), Computer Sciences Corporation, 31 March 1992.

l. Joint Services/DLA Computer Aided Acquisition and Logistic Support (JCALS) System, Software Requirements Specification, Book 2 - Network Management CSCIs (2/5), Computer Sciences Corporation, 31 March 1992.

m. Joint Services/DLA Computer Aided Acquisition and Logistic Support (JCALS) System, Software Requirements Specification, Book 3 - Data Management CSCIs (3/6), Computer Sciences Corporation, 31 March 1992.

n. Army Computer Aided Acquisition and Logistic Support (ACALS) System BCM Design Finalization Option, Software Development Plan, Computer Sciences Corporation, 15 July 1992.

o. CALS Human Computer Interface (HCI) Style Guide, Computer Sciences Corporation, September 1992.

1.4 Terms and Abbreviations

The terms and abbreviations used throughout this document are listed below:

ADP	Automated Data Processing
CAD	Computer Aided Design
CIM	Center for Information Management
CMW	Compartmented Mode Workstation
COTS	Commercial Off-the-Shelf
C3I	Command, Control, Communications, and Intelligence
DCE	Distributed Computing Environment
DDBMS	Distributed Data Base Management System
DEC	Digital Equipment Corporation
DISA	Defense Information Systems Agency
DOD	Department of Defense
GB	Gigabyte
GFI	Government-Furnished Information
GUI	Graphical User Interface
HCI	Human Computer Interface
HDS	Human Designed Systems
HQ	Headquarters
IBM	International Business Machines
ILS	Integrated Logistics Support
IWSDB	Integrated Weapons Systems Data Base

JCALS	Joint Computer Aided Acquisition and Logistics System
KB	Kilobyte
LAN	Local Area Network
MB	Megabyte
MIS	Management Information System
MLS	Multilevel Security
MMI	Man-Machine Interface
NAVAB	Navigation Application Broker
NCC	Network Control Center
NCE	Network Computing Environment
OA	Office Automation
OASD	Office of the Assistant Secretary of Defense
PC	Personal Computer
POSIX	Portable Operating System Interface for Computer Environment
RAM	Random Access Memory
RCAS	Reserve Component Automation System
RDBMS	Relational Data Base Management System
RISC	Reduce Instruction Set Computing
ROM	Read Only Memory
SCO	Santa Cruz Operation
SQL	Standard Query Language
TRM	Technical Reference Model
VDT	Video Display Terminal
WAN	Wide Area Network
WOM	Window Object Manager
XDM	X Display Manager

SECTION 2. BACKGROUND

2.1 Client-Server Concept

As described in the DMR document, "Networking Computing: Strategies for Open Systems," the TRM, and the "DoD Technicai Architecture Framework for Information Management." clients are defined as hardware, software, persons, or a combination requesting services from servers. Servers are defined as hardware, software, or a combination providing resources to one or more clients.

The client-server model is described as cooperative processing where an entire application is divided between a client system and a server system. Both client and server components are engaged in processing the application such that the software components interact to perform the function.

To describe an architecture in client-server terminology, the hardware and software components of the system must be defined as units that provide services to, or request services from, other system components. Figure 2-1 depicts a generic client-server model. Both the client and server may reside on the same hardware platform but in many cases are on separate platforms. The critical aspect of the client-server process is the request/reply interprocess communication between client and server.

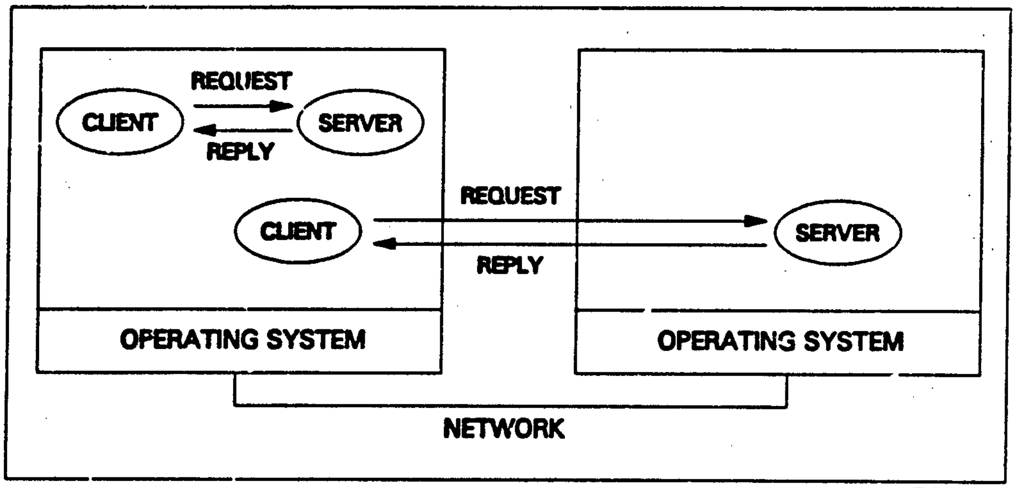

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Figure 2-1. Basic Client - Server Model

Standards are a crucial element in client-server architectures since they define the interface between clients and servers. The standardization of these interfaces allows client-server communications to operate effectively in an open systems environment. Two major architectural standards are evolving to provide guidelines and definitions for client-server architectures: the Open Software Foundation's (OSF's) Distributed Computing Environment (DCE), and UNIX International's (UI's) Open Network Computing (ONC). Further, standards are applied in virtually all areas of the DoD TRM model to define interfaces between services.

The fact that client-server architectures are not mature must be considered when implementing a client-server system. Organizations are often forced to choose among proprietary approaches. In general, the recommended approach is to define an application and its information requirements as sets of generic components that can be implemented throughout a network computing environment (NCE). This results in defining a system as a set of services and the interfaces between these services and components that require their use. An emerging standard approach is to separate the user interface/application code and have them reside on a workstation while the data bases, triggers, and stored procedures reside on servers. Figure 2-2 illustrates the five basic client-server models.

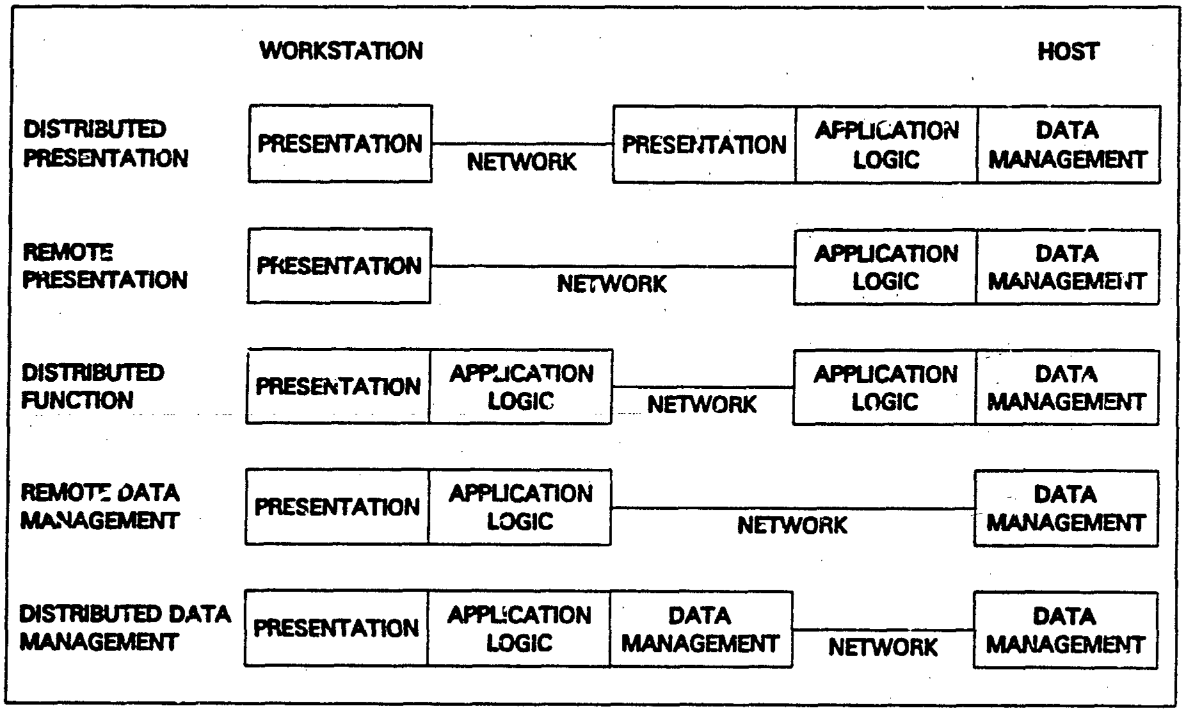

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Figure 2-2. Five Basic Client - Server Models

The cost savings of implementing a client-server architecture will be realized when the architecture becomes stable. The current, conventional application environment requires each CICS user, for example, to use mainframe CPU cycles, disk queues, and RAM. These same operations are orders of magnitude cheaper on the workstation. Also, existing workstations that typically are used for personal productivity applications such as terminal emulation, E-mail, word processing, and spreadsheet work may be used for mission-critical applications. The additional functionality of the client portion of a new application can thus be added without buying a new workstation. In this case, the cost savings of offloading mainframe processing can be substantial. If client and server functionality are clearly split and standards-based access is used, considerable vendor independence may exist among application components.

Many organizations are beginning to view workstation technology as a commodity and select lower-priced vendor equipment. Mainstream vendors have realized this trend and are moving to provide competitively priced client workstations. Each mainstream vendor (e.g., IBM, Compaq, Apple, Sun, Hewlett-Packard) reduced its prices by at least 33 percent during 1991, primarily in response to an erosion of market share for client workstations.

The client-server paradigm is developing. Standards issues that must be decided include the use of RDA as a standard interface to an SQL data base engine, the use of RPCs, and the type of RPC to implement (NCS RPC, TI/RPC, or RPC TOOL or some other RPC implementation). The initial startup costs of a distributed client-server system will probably remain higher over the short term than a conventional, non-client-server system. Over time, as these systems and standards stabilize, significant cost savings should occur.

2.2 User Interface Concept

Today's emerging graphical user interface (GUI) standard is the (network-aware) X Window System. The GUI is rapidly becoming an integral part of the end user's application interface. A GUI alleviates the need for each user to become proficient in the use of the operating system. The advantage of implementing an X Windows GUI is that it is a CIM standard and an industry standard for network-aware GUIs.

Using an X Window toolkit such as MOTIF insulates the user from the technical complexities of the operating system, and provides a see-and-point user interface. A toolkit allows developers to interface with the X Window system and customize the end user displays without having to learn X lib (low-level X Windows routines) commands and syntax. Typical implementations of a toolkit on top of X results in a window populated with icons. The icons are graphic representations of applications or processes that can be selected and invoked with a mouse button.

X Windows can be displayed on any hardware device that supports the X protocol. A window manager provides session and window management capabilities. It creates the border that forms around every window, enabling the window to be moved, resized, overlapped, shuffled, and reduced to an icon within the desktop.

2.3 RCAS Overview

The RCAS is a large DoD program that will provide automated information system (AIS) and communications capabilities to hundreds of U.S. Army Reserve and Army National Guard Component facilities. The equipment and services provided by the RCAS will significantly enhance command and staff decision-making, force readiness, and mobilization planning and execution activities. The program is expected to realize significant cost savings and avoidance.

The RCAS Program Management Office (PMO) and its primary contractor, Boeing Computer Services (BCS), will procure and implement various AIS and telecommunication system configurations, ranging from remote stand-alone workstations or terminal devices with a dial-up capability to large complements of LAN-based servers, workstations, terminals, peripherals, and telecommunications equipment. The hardware, software, and telecommunications system components are described in the following subsections.

2.3.1 Hardware. The RCAS will consist of five AIS platforms: X-stations, workstations, office automation (OA)/terminal servers, electronic mail (E-mail) servers, and application servers. Figure 2-3 illustrates the interconnectivity of the AIS platforms via the RCAS telecommunications system (TCS).

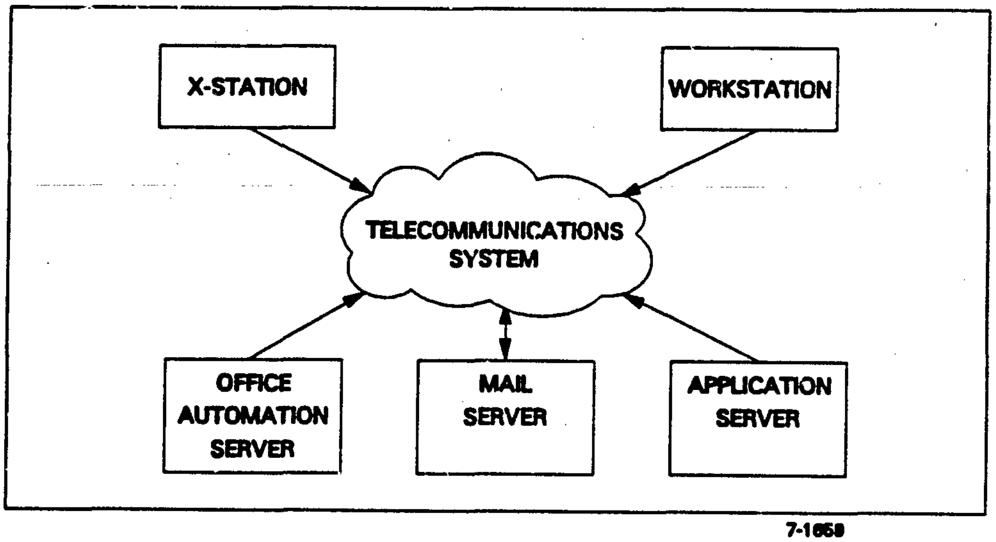

Figure 2-3. RCAS AIS Interconnectivity

The AIS platforms are described below:

- X-stations: High-resolution, intelligent terminal devices that will be the primary end user device for the RCAS. Four types or models will be implemented for the RCAS program. Two monochrome (17-inch and 19-inch) models and one color (14-inch) model will be employed by the end users. A fourth X-station model (19-inch color) will be used with the network management application at the RCAS Network Control Center (NCC).

- Workstations: Zenith Data Systems 486/33 Mhz PCs, used in lieu of X-stations for processor and memory-intensive computer-aided design (CAD) and graphical mapping applications. The workstations are equipped with 19-inch high-resolution color monitors, 32 MB of memory, and a three-button mouse. They support the same man-machine interface (MMI) as the X-stations, providing consistency across hardware platforms.

- Office Automation/Terminal Server: A Zenith Data System 486/33 Mhz computer configured with 24 to 64 MB of memory and peripherals. Each OA server can support up to eight concurrent users at echelons where both the office automation software and RCAS applications/data bases reside on the OA server. The OA server can support up to 16 concurrent users at echelons where the OA server only supports the office automation software applications.

- E-Mail Server: The E-mail server is a DEC system 5500 configured with 256 MB of memory and 5 or 10 GB of hard disk storage. Mail servers are provided at each wide area network (WAN) hub to accommodate the large WAN transmissions that occur during mobilization. The mail servers provide mail store-and-forward services for the RCAS electronic mail.

- Application Server: The application server is a DEC System 5000/200. DEC System 5500 computers are used for the RCAS application/data base servers. The DEC system 5000/200 is configured with 128 MB of memory and 2 to 4 GB of hard disk storage. The DEC System 5500 is configured with 256 MB of memory and 2 to 10 GB of hard disk storage. This server employs a DEC Reduced Instruction Set Computing (RISC)-based processor, which hosts the applications and data base processes, improving performance and response time.

2.3.2 **Software**. The RCAS program includes sets or suites of standard software products to be used with the five AIS platforms. The software suites are defined in terms of three functional areas or groups: OA, support software, and application software. Table 2-1 presents the three software groups and the components or applications associated with each group. The table also depicts the appropriate AIS platforms that house the software groups.

Table 2-1. RCAS Software Environment

SOFTWARE GROUP	SOFTWARE COMPONENTS (APPLICATIONS)	AIS PLATFORM
Office Automation	Word Processing Spreadsheet Electronic Mail Desktop Organizer Personal DBMS Presentation Graphics Project Manager Desktop Publisher	OA Server, Workstation
Support	Operating System Administration Tools Graphical User Interface Secure Communications DBMS Text Retrieval Bar Code Printing CAD/CAM Map Graphics CBT OCR Linear Programming	OA Server, Combined OA/Application Server NOTE: The three servers and the workstation platforms are configured with operating system, system administration, GUI, and communications software.
Application	Mobilization Command and Control Aviation Operations Force Authorizations Human Resources Training Resource Management Logistics International Facilities Safety Information Internal Review Program	Application, Combined OA/Application Servers

A fundamental design objective for the RCAS program was to achieve "immediate usability and mission acceptance." To accomplish this goal, a consistent, user-friendly MMI is required. The suite of software products selected for the RCAS meet this requirement and provide a standard look and feel MMI. Specific examples are presented below:

- o Each OA server platform runs under the Santa Cruz Operation (SCO) CMW+ operating system environment. Therefore, every RCAS user will be provided a common GUI and MMI. At small sites, the OA and application server software suites will be housed in a single server platform. At larger sites, the server software suites will be housed on separate server platforms.

- o The E-mail servers will run the DEC ULTRIX MLS+ operating system, providing mail store-and-forward services to RCAS users.

- o The X-station models contain minimal software in onboard Read Only Memory (ROM), and rely on downloading the X-server software and supporting configuration parameters from the host (i.e., Zenith 486 OA server running CMW+/386). When the X-station is powered on, it sends a broadcast message expecting a response from a CMW host. The host that has the X-station configured in its tables will return an address to the X-station. The X-station can then establish communications with the host and download its configuration file, X-server, and fonts. When the X-station has completed its configuration, the X Display Manager (XDM) on the CMW host downloads the login screen, which is displayed on the X-station by the trusted X-server. XDM manages the login screen to ensure that the trusted path is active between the X-station and CMW host. The GUI promotes ease of use for all levels of users, from inexperienced to very experienced, reducing the amount of training time required.

2.3.3 Communications. In addition to providing the information processing platforms described in the previous subsections, the RCAS program includes a telecommunications system to address the connectivity requirements of the various end users. The TCS will enable connectivity between RCAS end systems and user terminal devices via a dedicated router-based WAN. The WAN will link many LANs, and will support connectivity for dial-up access and gateway connections to external networks. The TCS will support both the GOSIP and DDN protocol stacks, and will provide the following services:

- o Transaction processing (application-to-application)
- o File services (access, transfer, and management)
- o E-mail (X.400 mail service)
- o Remote batch (remote job submission)
- o Interactive (access to RCAS application processors)
- o Network management (system operations centers).

The WAN is based on a three-tiered architecture. The first tier (Level 1) consists of five backbone router nodes connected in a full mesh configuration. The second tier (Level 2) consists of regional nodes generally located at State Area Reserve Centers (STARCs). The Level 2 nodes act as hubs for lower echelon dedicated circuits in their area. The third tier (Level 3) nodes are dedicated access nodes that typically have a single connection to the RCAS TCS network. Finally, small non-LAN-based sites are connected to the TCS via dial-up X.25 circuits.

National Security Agency (NSA)-approved end-to-end network encryption devices will be implemented for LAN-based traffic, and STU-III link encryption devices will be used to provide security for the X.25 dial-up circuits.

Finally, the RCAS TCS also includes network management capabilities implemented via a complement of hardware and software products that will be housed in a primary and secondary Systems Operations Center (SOC).

2.4 JCALS Overview

The JCALS effort is the result of previous logistic endeavors to combine the direction and resources of Service-specific logistics systems to provide a standard unified logistics system usable across all Services and the Defense Logistics Agency (DLA). The entities that precede JCALS include Army CALS, DLA CALS, Air Force CALS, Marine Corps CALS, and Navy CALS. Each has several goals or objectives toward providing logistics to their respective Service or agency.

Army CALS objectives were to provide logistic information sharing among various users; provide a common and integrated structure for organizing data; provide an interface among government end users, government agencies, and concerned industries; implement DoD-wide standards for logistics and technical information; provide uniform ILS and reliability, availability, and maintainability tools for weapon system developers; and provide a flexible architecture that can grow into the next century.

DLA CALS was the combination of CTOL, EDMICS, MEDALS, MPCASS, DRAMA, DLIS, and ITAP. The current and planned functions of these systems include cataloging new items entering the supply system, automating DLA repositories and technical libraries, indexing tt chnical data elements, identifying specific DoD repository locations, automating the interface between contractors and the military parts control advisory group, and enhancing the validation of supply requests.

Air Force CALS has had a vision cf interconnecting the seven current systems that provide logistic information within that Service. Their vision of interconnection would consist of installing communications gateways, networks (both local area and wide area), and interfaces and translators, and connecting functional workstations and processors to provide access to logistics information.

Marine Corps CALS was a combination of many entities, including the Logistics Information Systems Branch; the Marine Corps Logistics Base; the Marine Corps Research, Development, and Acquisition Command; and the USMC Combat Development Command.

Navy CALS was identified as a consortium of information based on Navy Items of Automation (IOAs).

On 11 January 1991, the Major Automated System Information Review Committee issued a System Decision Memorandum that directed PM Army CALS to incorporate minimum essential requirements of the Air Force, Navy, Marine Corps, and DLA into the Army CALS program. On 4 October 1991, the Assistant Secretary of Defense for Production and Logistics issued a memorandum establishing the JCALS program as a Joint Defense program.

2.4.1 Hardware. JCALS consists of six hardware groups: data management processors (DMPs), workstation servers, workstations, input devices, output devices, and storage devices. The hardware groups are highlighted below:

- Data management processors. The DMPs can be viewed as a single processor with the capability of accessing remote data management systems through the use of software and communications subsystems. The DMPs will be capable of supporting an ANSI X3.135 SQL-compliant relational data base management system (RDBMS). The RDBMS is a multilevel secure, commercial off-the-shelf relational DBMS that can access distributed JCALS data. This secure DBMS, currently INFORMIX, is coupled with the Global Data Management System (GDMS), which provides the access to data distributed across the Integrated Weapons Systems Data Base (IWSDB), to provide all data access within the distributed environment. The secure DBMS runs under a B1-rated UNIX operating system and is designed to meet the B1 Trusted Computer Security that provides the capability to store classified and unclassified data. In addition, a COTS text DBMS, currently BASISPLUS, is used to access SGML tagged information.

- Workstation servers. The workstation server will support a POSIX-compliant operating system and provide a work group-level storage, data management, printing, and communications capability. The workstation server will also support transparent remote data access; digitization; and compression of input data, raster and vector graphics, and optical media. The workstation server will be able to receive and route data from local workstations to remote workstations and peripherals.

- Workstations. JCALS will support three types of workstations:

    - A CAD/CAE workstation for CAD/CAE functions as well as ILS/RAM workbench activities

    - A color user workstation, which supports users requiring color graphics and limited ILS/RAM workbench activities

    - A user workstation, which provides access to resources on the workstation server.

- Input devices. Input devices include scanners, punch card readers, and Microfiche readers.

- Output devices. Output devices include printers, plotters, and high-resolution color and CAD/CAE monitors.

- Storage devices. As a result of the differing requirements for storage media, the following storage devices are supported by JCALS:

  - DMP disk
  - Workstation server disk
  - CAD/CAE workstation disk
  - Optical disk jukebox
  - Optical disk drive
  - Helical scan tape drive
  - 9-track tape drive.

2.4.2 Software. The JCALS program includes sets or suites of standard software products to be used with the AIS platforms. The software suites are defined in terms of three functional groups: workstation, network management, and data management software. Table 2-2 presents the components of the three software groups and vendor/product information for the appropriate software component.

A fundamental design objective of the JCALS program was to achieve "immediate usability and mission acceptance." To accomplish this goal, a consistent, user-friendly MMI is required. The suite of software products selected for the JCALS meet this requirement and provide a standard look and feel MMI. The JCALS human-computer interface will consist of X11 and OSF/MOTIF 1.1 as a base from which to expand. MOTIF will provide the "look and feel" of the application. On the other hand, X11 will provide support for user interaction. MOTIF will provide a presentation User Interface Language (UIL) that will describe the visual aspects of the user interface in text format in a file. A window manager also will be provided to manage the operation of all windows on the end user's screen.

The JCALS system will enable the end user to provide user interfacing by several different methods: direct manipulation, object-action selection, menu selection, text entry, and a command language. Each method will provide the user with ample opportunities to interact with the JCALS system in an efficient, user-friendly, easy-to-learn method, and will provide tools for the more experienced end user.

2.4.3 Communications. The network architecture is organized into the three tiers shown in figure 2-4. Tier 1 is the Regional Service Center Tier. This tier is the System Operational and Support Capacity (SOSC). The purpose of the SOSC is to monitor and evaluate the performance of the JCALS network. When issues with the network exist, the

Table 2-2. JCALS Software Environment

SOFTWARE GROUP	SOFTWARE COMPONENT	VENDOR/PRODUCT
Workstation	Operation System	DEC ULTRIX MLS+
	Desktop Manager	IXI X.Desktop
	Online Help	IXI X.Deskhelp
	Office Automation	Applix Asterix
	Low-End Electronic Publishing	Arbortext SGML Publisher Arbortext Island Paint Arbortext Island Draw Arbortext CALS Filters
	SGML Editor	Arbortext SGML Editor
	1840A Read/Write Utilities	Infodesign 1840A Read/Write Utilities
	SGML Auto-Tagger	Avalanche FastTag
	Interactive Technical Manual Browser	Excalibur EFS
	Technical Illustrator	Autotrol TI Plus with Raster Autotrol S5000 Mid Autotrol SQL Autotrol Postscript
	Drawing Viewer/Redliner	Rosetta Prepare Rosetta Preview
	ILT/RAM Tools	ISS SLIC ISS FMECA ISS LORA ISS LSC MSI Predictor MSI C-Maintainability MSI Results MSI Reality MSI FRACAS Viewlogic Workview Series II with VHDL Package MSI Block Diagram Evaluator
	Low-End CAD	Autodesk Autocad
	Concurrent Engineering	Aries DXF Pre/Post Aries Concept Solids Aries Concept Mass Aries Concept Materials Aries Printer Support
	Project Management	Productivity Solutions Ultra Planner
	Teleconferencing	Saratoga Information Systems XPCS
Network Management	Operating System	DEC ULTRIX MLS+
	Communications	System Strategies Easy Bridge SNA/3270 Advanced Communications Concepts ACP 3250 Advanced Communications Concepts OSI
	Communications Management	DEC Management Station for ULTRIX
Data Management	Operating System	DEC ULTRIX MLS+
	Data Base Management System	Sybase Secure Server
	Text Data Base Management System	Information Dimensions Basis Plus
	Multiple Data Base Interface	Sybase Open Host Server Information Builders EDA SQL
	Jukebox Interface	Q-Star Optical Disk Jukebox Software

TIER 1 - REGIONAL SERVICE CENTER		SYSTEM OPERATIONAL AND SUPPORT CAPABILITY	
TIER 2 - ORGANIZATION	WORKSTATION SERVERS	DATA MANAGEMENT PROCESSORS	NETWORK PROCESSORS
TIER 3 - USER	USER WORKSTATIONS	COLOR USER WORKSTATIONS	CAD/CAE WORKSTATIONS

7-1742

Figure 2-4. Tiered Network Architecture

responsibility of SOSC is shifted from monitoring to problem-solving. SOSC logs all issues and either takes corrective action or contacts the local sites so that action can be taken. SOSC also performs network management and network security.

Tier 2 is the Organization Tier and is composed of three components. The first component is the Workstation Server, which is used to connect the workstations to the rest of the network. The second component is the Network Processor, which is used to control and link the local site network to the WAN. The last component is the Data Management Processor, which is used to collect network statistics at each site and relay this information back to the SOSC.

Tier 3 is the User Tier. This tier also consists of three components: user workstations, color user workstations, and CAD/computer-aided engineering (CAE) workstations. Tier 3 is basically software and hardware used at the user level to connect, retrieve, and process information off the network.

2.4.4 <u>Site Overview</u>. Tier 1 (SOSC) is the overall monitoring and control center. Tiers 2 and 3 describe the sites that Tier 1 is supporting. A typical Tier 2/Tier 3 site consists of four subsystems:

- o Network Management
- o Data Management
- o Workstation
- o Network Distribution.

Each site uses the four subsystems to communicate. The Network Management Subsystem performs the communications between the sites using a WAN. The Network Management Subsystem also links the network with the existing systems. The Network Management Subsystem (JCALS network) and the existing systems communicate through connectivity provided by IEEE 802.3.

The Data Management Subsystem is responsible for administration, updating, and control access. Further responsibilities are to route and maintain the status of user queries and responses.

The Workstation Subsystem provides users with software and hardware that will enable them to communicate, use office automation, and perform engineering functions and CAD.

The Network Distribution Subsystem provides system interfacing within the site.

The JCALS network is shown in figure 2-5. This figure shows the LANs and the structure described above, and its also shows how the LANs are tied together using the WAN and the SOSC.

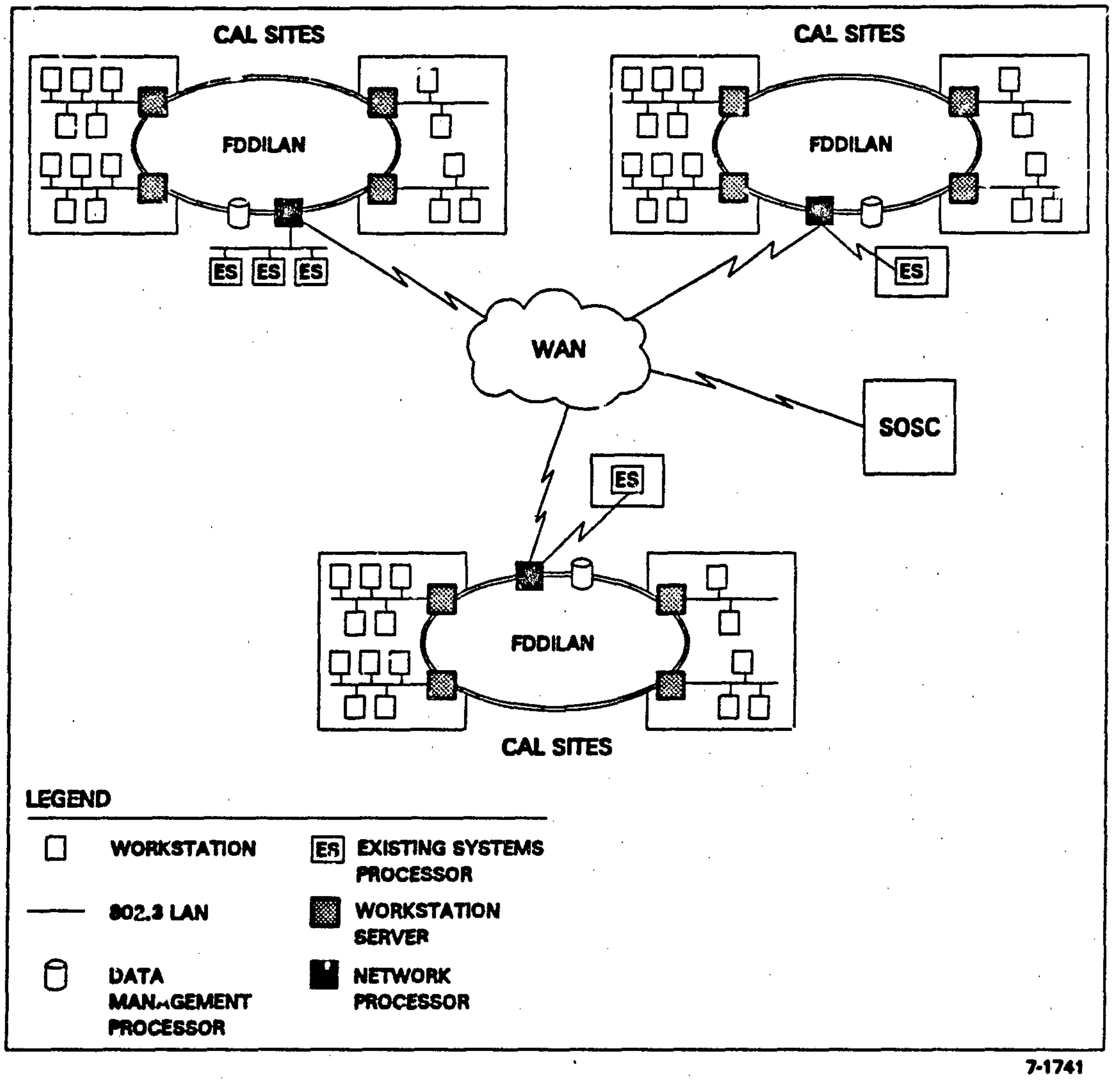

Figure 2-5. JCALS Network

SECTION 3. EVALUATION METHODOLOGY

3.1 Evaluation Methodology Overview

This section presents the techniques and procedures used in evaluating the RCAS and JCALS programs. The RCAS evaluation process consisted of an analysis of the RCAS systems architecture with respect to client-server technology and user interface methodology, and an economic analysis of the RCAS program to determine the suitability of applying these methodologies and approaches to other DoD functional areas.

3.2 RCAS Evaluation Methodology

The RCAS evaluation process consisted primarily of a review and analysis of the related RCAS system documentation listed in section 1.3 of this report. To augment this process, evaluation team members attended software demonstrations designed to demonstrate the functional capabilities of RCAS. These software demonstrations were presented by one of the primary RCAS software vendors (UNIPLEX) and the RCAS system developers located at the RCAS PMO demonstration facility.

For clarity, the activities conducted during the RCAS evaluation are summarized in table 3-1. This table identifies the evaluation stages, activity performed during the stage, and the section in this report where the activity is described in detail and where the associated results are provided.

Table 3-1. RCAS Evaluation Methodology Summary Matrix

STAGE	EVALUATION ACTIVITY	DETAILED DISCUSSION	RESULTS
1	Devolop a formal definition for client-server architecture	Section 3.2.1	Section 4.1.1
2	Evaluate RCAS to identify client-server models available from RCAS hardware and software components	Section 3.2.1	Section 4.1.1
3	Assess compliance of hardware/software components used for client-server models with DoD TRM	Section 3.2.1	Appendix A
4	Assess RCAS hardware and software component compliance with DoD HCI Style Guide	Section 3.2.2	Appendix B
5	Conduct RCAS Economic Analysis	Section 3.2.3	Section 4.1.3
6	Attend software demonstrations to validate findings resulting from evaluation of RCAS program	Sections 3.2.1, 3.2.2, 3.2.3	Appendix A and B
7	Document results and develop conclusions	Sections 3.2.1, 3.2.2, 3.2.3	Section 4 and all appendixes

3.2.1 Client-Server Evaluation Methodology. To support the client-server evaluation process, the following methodology was implemented:

- o Reference Stage 1. An operational definition of the client-server model(s) was abstracted from information contained in three reference documents: Chapter 10 of the Defense Management Review (DMR), "Strategies for Open Systems"; Volume 2 of the "DoD Technical Architecture Framework for Information Management"; and Version 1.3 of the DISA Center for Information Management "Technical Reference Model for Information Management."

- o Reference Stage 2. The RCAS systems architecture and AIS platforms were evaluated with respect to the derived client-server architecture definition. The evaluation was based on a review of the RCAS Systems Specification and the Software, Hardware, and Telecommunications Subsystems Specification documents.

- o Reference Stage 3. The DISA Center for Information Management "Technical Reference Model for Information Management" document was reviewed and applicable standards were extracted and included in a compliance matrix checklist. Chapter 10 of the DMR, "Strategies for Open Systems," references the OSF DCE as a standard to be used for evaluating client-server architectures. However, in the DoD community, the OSF DCE standard is represented by the DoD TRM. Therefore, the DoD TRM was used in evaluating the RCAS program.

- o Reference Stage 6. Software demonstrations of the software component UNIPLEX and the RCAS program were attended on 17 and 21 September 1992, respectively. The demonstrations were used to verify information obtained through review of RCAS system documentation and to assist completion of the DoD TRM matrix provided in appendix A.

- o Reference Stage 7. The results of each stage of the evaluation are documented in the appendixes of this document.

3.2.2 User Interface Evaluation Methodology. To support the user interface evaluation process, the following methodology was implemented:

- o Reference Stage 4. The DoD "Human Computer Interface (HCI) Style Guide" was reviewed and user interface requirements were developed. These requirements were documented in a DoD HCI Style Guide compliance matrix (see appendix B). A thorough and comprehensive analysis of RCAS user interface documents was then conducted to assess RCAS compliance with the requirements documented in the compliance matrix.

- o Reference Stage 6. Software demonstrations of the software component UNIPLEX and the RCAS program were attended on 17 and 21 September 1992, respectively. The demonstrations were used to verify information obtained through review of RCAS user interface documentation and to assist completion of the DoD HCI Style Guide compliance matrix provided in appendix B.

- o Reference Stage 7. The results of each stage of the evaluation were documented and are included in the appendixes of this document.

3.2.3 Technical Economic Analysis Evaluation. To support an economic analysis of the RCAS program, a benefit analysis was conducted using the following methodology:

- o Reference Stage 5. The RCAS Benefits Analysis (BA) is based on the functionality of RCAS and the Milestone 1 BA. From these, the following candidate tangible benefits were identified:

  - Man-hours avoided by automation in completing, staffing/approving, or hand-carrying a form during distribution. (Cost avoidance)

  - Long-distance telephone calls saved through automation. (Cost savings)

  - Reproduction (Xeroxing) of forms saved through automation. (Cost savings)

  - Transmission of forms saved through automation (transmission of forms currently occurs throu:h vehicles such as facsimile (FAX), overnight mail delivery, and regular mail delivery). (Cost savings)

From the above candidates, a total of $3.2 billion in constant FY 91 dollars or $5.1 billion in inflated dollars during the period of FY 92 through FY 02 in tangible savings was projected over the expected life of the RCAS system.

The RCAS Functional Description (FD) defines the specific actions required to be performed at the designated echelons and generates the requirements for automation support. The level at which these processes occur is critical to the design of the requirements.

Projected benefits were quantified from two groups of information:

- o The amount of resources spent completing administrative processing through current procedures

- The amount of current resources that the Reserve Component will save/avoid as a result of the RCAS.

The first group was collected primarily via mailed questionnaires from randomly selected units representing the population of prospective RCAS users. Approximately 800 questionnaires were mailed, resulting in over 250 responses. Additionally, analysts visited units in Georgia and Texas, collecting data through on-site interviews.

The second group was derived through FD review and Competitive Demonstration observation, and provided the basis for estimating RCAS efficiencies.

3.3 JCALS Evaluation Methodology

The JCALS evaluation process consisted of an analysis of the JCALS systems architecture with respect to client-server technology, and user interface methodology to determine the suitability of applying these methodologies and approaches to other DoD functional areas.

The JCALS evaluation process consisted primarily of a review and analysis of the related JCALS system documentation listed in section 1.3 of this report. To augment this process, evaluation team members attended software demonstrations designed to demonstrate the functional capabilities of JCALS. These software demonstrations were presented by JCALS system developers.

For clarity, the activities conducted during the JCALS evaluation are summarized in table 3-2. This table identifies the evaluation stages, activity performed during the stage, and the section in this report where the activity is described in detail and where the associated results are provided.

Table 3-2. JCALS Evaluation Methodology Summary Matrix

STAGE	EVALUATION ACTIVITY	DETAILED DISCUSSION	RESULTS
1	Develop a formal definition for client-server architecture	Section 3.3.1	Section 4.2.1
2	Evaluate JCALS to identify client-server models available from JCALS hardware and software components	Section 3.3.1	Section 4.2.1
3	Assess compliance of hardware/software components used for client-server models with DoD TRM	Section 3.3.1	Appendix C
4	Assess JCALS hardware and software component compliance with DoD HCI Style Guide	Section 3.3.2	Appendix D
5	Attend software demonstrations to validate findings resulting from evaluation of JCALS program	Sections 3.3.1, 3.3.2, 3.3.3	Appendix C and D
6	Document results and develop conclusions	Sections 3.3.1, 3.3.2, 3.3.3	Section 4 and all appendixes

3.3.1 Client-Server Evaluation Methodology. To support the client-server evaluation process, the following methodology was implemented:

- Reference Stage 1. An operational definition of the client-server model(s) was derived from information contained in three reference documents: Chapter 10 of the DMR, "Strategies for Open Systems"; Volume 2 of the "DoD Technical Architecture Framework for Information Management"; and Version 1.3 of the DISA Center for Information Management "Technical Reference Model for Information Management."

- Reference Stage 2. The JCALS systems architecture and AIS platforms were evaluated with respect to the derived client-server architecture definition. The evaluation was based on a review of the JCALS Systems Specification, and the Software, Hardware, and Telecommunications Subsystems Specification documents.

- Reference Stage 3. The DISA Center for Information Management "Technical Reference Model for Information Management" document was reviewed, and applicable standards were extracted and included in a compliance matrix checklist. Chapter 10 of the DMR, "Strategies for Open Systems," references the OSF DCE as a standard to be used for evaluating client-server architectures. However, in the DoD community, the OSF DCE standard is represented by the DoD TRM. Therefore, the DoD TRM was used in evaluating the JCALS program.

- Reference Stage 4. Software demonstrations of JCALS were conducted. The demonstrations were used to verify information obtained through review of JCALS system documentation and to assist completion of the DoD TRM matrix provided in appendix C.

- Reference Stage 5. The results of each stage of the evaluation are documented in the appendixes and tables of this document.

3.3.2 User Interface Evaluation. To support the user interface evaluation process, the following methodology was implemented:

- Reference Stage 3. The DISA Center for Information Management "Technical Reference Model for Information Management" document was reviewed, and applicable standards were extracted and included in a compliance matrix checklist. Chapter 10 of the DMR, "Strategies for Open Systems," references the OSF DCE as a standard to be used for evaluating client-server architectures. However, in the DoD community, the OSF DCE standard is represented by the DoD TRM. Therefore, the DoD TRM was used in evaluating the JCALS program.

- Reference Stage 4. The DoD "Human Computer Interface (HCI) Style Guide" was reviewed and user interface requirements were developed. These requirements were documented in a DoD HCI Style Guide compliance matrix (see appendix D). A thorough and comprehensive analysis of JCALS human-computer interface documents was then conducted to assess JCALS compliance with the requirements documented in the compliance matrix.

- Reference Stage 5. A software demonstration of the components of the JCALS program was attended. The demonstration was used to verify information obtained through review of JCALS human-computer interface documentation and to assist completion of the DoD HCI Style Guide compliance matrix provided in appendix D.

- Reference Stage 6. The results of each stage of the evaluation were documented and are included in the appendixes of this document.

SECTION 4. FINDINGS

4.1 RCAS Findings

After analyzing the results of RCAS evaluation efforts, the following general findings and conclusions were developed concerning the RCAS systems architecture. Specific conclusions were developed for each of the three areas analyzed during the RCAS evaluation: client-server, user interface, and RCAS Economic Analysis Report. The general findings and conclusions on the RCAS systems architecture are provided below, and specific conclusions for the functional areas analyzed are provided in the following subsections.

The RCAS systems architecture is a well-founded and comprehensive open systems, standards-based architectural model. In addition to rules and guidelines, the system architecture is composed of the following four key elements:

- Information Model (IM): Defines the overall RCAS information structure in terms of processes, information classes, and organizational use of information. The IM is used to define the three architectural elements of the system architecture.

- Data architecture: Provides a high-level data view used to define data sharing and distribution requirements and to support data base design and analysis efforts, and is used in the formation of the data dictionary.

- Application architecture: Provides guidelines for application development, and identifies candidate applications to replace manual processes and application interdependencies.

- Geographic/technical architecture: Identifies the location or geographic distribution, communications connectivity, and technical performance data and application distribution requirements.

4.1.1 Client-Server Findings. The following describes the RCAS client-server system and presents general findings of the RCAS client-server system.

4.1.1.1 Description of the RCAS Client-Server System. Of the five basic client-server models delineated in section 2, RCAS has components that adhere to only the remote presentation model as illustrated in table 4-1. Currently, no other client-server interfaces exist for the RCAS servers (Zenith 486 platforms) nor are there plans to implement such an architecture in the near future, although the current and future hardware (DEC RISC servers) and software will support a client-server configuration.

Table 4-1. RCAS Client-Server Environment

COMPONENTS	RCAS CLIENT	RCAS SERVER
Hardware	Human Design System (HDS) X Station	486 Server DEC System 5000/200 DEC System 5500
Software	X Windows Client OSF/MOTIF GUI	OA Server Application Server

A UNIX pipes IPC interface to the Data Object Manager (DOM) exists, which communicates to the Data Synchronization Manager (DSM) through a pipes interface. This IPC between the DOM, DSM, and the rest of RCAS is an example of a client-server architecture where both client and server are on the same computer.

Utility-type client-server processes also exist that are transparent to the end user and thus are not traditional client-server applications. These applications (e.g., MaxSix, Secure X windows) primarily deal with trusted labeling and other security features.

4.1.1.2 Findings. It may be beneficial to investigate using Control and Analysis Tool (CAT) Project Manager as a front-end interface. This tool has a 4GL, supports SQL, and could be combined with an SQL engine such as INFORMIX on a separate platform. Other front ends, such as INFORMIX SQL 4.1, and X Windows-compliant front ends with an INFORMIX API also should be considered.

Currently, the X Server is downloaded to each client machine at bootup. If client workstation random access memory (RAM) becomes scarce, it may be more beneficial to consider a remote invocation of the X Server from the client. This would result in the distributed presentation client-server model.

Any baseline distributed client-server technical approach should consider implementing the following:

- A distributed COTS SQL-compliant and RDA-compliant relational DBMS. Such a DBMS should be supported, although contractor-developed software may suffice (e.g., JCALS GDMS). Support for and enhancements to the DBMS should be included in the procurement.

- A POSIX-compliant (preferably UNIX) operating system. UNIX is the *de facto* standard in open operating systems and it easily supports the client-server paradigm with its sockets IPC. In addition, many UNIX versions are POSIX-compliant.

- o A client-server IPC that implements an RPC or Berkeley Sockets. The concept of an RPC is developing. The idea behind a remote procedure call is to mimic local appli.ation development while transparently using the low-level IPC to communicate to remote procedures. Using RPC instead of writing low-level IPCs such as sockets could save a tremendous amount of development time.

- o A user interface that implements X Window with MOTIF or OPEN LOOK. The X Window/MOTIF user interface has been demonstrated in RCAS and JCALS. Both use Ada language binding, and communicate through Pipes (RCAS) or Sockets (JCALS) to server applications.

- o Source code written in Ada. Ada is a demonstrated robust language and handles client-server communications adequately. This was shown in the Data Object Module and Data Synchronization Module of RCAS and the Global Data Management System (GDMS) of JCALS.

The open systems, standards-based RCAS systems architecture, AIS platforms, and telecommunications system are fully capable of housing/supporting client-server applications.

4.1.2 User Interface Findings. The following subsections describe the user interface system implemented in RCAS and present a summary of findings. Most of the findings regarding the RCAS user interface are based on the review of the results of RCAS compliance with the DoD HCI Style Guide. These results are shown in appendix B. Additional conclusions were developed as a result of the RCAS demonstration provided by the Boeing Company on 21 September 1992.

4.1.2.1 Description of the User Interface System. The RCAS GUI is based on the X Window System (X11 Rel 4) and the OSF/MOTIF Graphical User Interface (Rel 1.1.1). The GUI is an integral part of the user's view of the RCAS and alleviates the need for each user to become proficient in the use of the operating system. The Open Desktop GUI, which RCAS uses, includes the Desktop Manager, X Window System, and the MOTIF Window Manager.

The Desktop Manager insulates the user from the technical complexities of the operating system, and provides a see-and-point user interface. The desktop is a window populated with icons. The icons are graphic representations of applications or processes. The X Window system provides for the development of portable GUIs.

Windows can be displayed on any hardware device that supports the X protocol. The MOTIF Window Manager provides session and window management capabilities. It creates the border that forms around every Open Desktop Window, enabling the window to be moved, resized, overlapped, shuffled, and reduced to an icon within the desktop.

The office automation environment of the RCAS is provided through the use of UNIPLEX COTS software. UNIPLEX Windows provides the capability to run the UNIPLEX applications under the Desktop Manager and X Window components environment.

The GUI utilities are designed as trusted applications using Ada. The GUI utilities consist of the Window Object Manager (WOM), the Navigation Application Broker (NAVAB), and Help.

The WOM provides a consistent user interface throughout the RCAS. It is a generalized GUI and presentation manager engine. It performs presentation management functions on behalf of the application (client) program by using X Window and MOTIF products to construct dialogues with the users. The WOM is started by the RCAS desktop and is responsible for interaction with the POSIX-compliant operating system processes. The WOM interprets interprocess communication data received from the client, detects either presentation (display) or dialogue (data entry) requests, retrieves appropriate information, and applies them to the user's video display terminal (VDT). The WOM also notifies the user of system activity if responses are not received within 15 seconds of a user-initiated action. During dialogue management, the WOM provides the primary data validation mechanism for data entering the RCAS. The WOM directs the MOTIF Window Manager to allow input of only certain characters. The WOM also provides user access to Help.

The NAVAB provides the user with generalized access to RCAS application functions. It provides the capability to request blank forms, allows for quicker access to applications by maintaining a log of applications executed by the user, and provides a standardized functional process to select a particular application for execution. The NAVAB interfaces through the WOM to provide the necessary menus needed to navigate the RCAS.

The Help utility provides the user with assistance on the use of RCAS applications. The Help functionality is bundled into the WOM. Two types of Help are available to the RCAS user: general subject/topical and field definitions/descriptions.

4.1.2.2 Findings. RCAS had over a 90 percent compliance rate for user interface requirements where sufficient information was available to make an assessment.

The RCAS user interface is based on an OSF/MOTIF approach. DoD HCI Style Guide requirements addressing an OPEN LOOK approach to a user interface were determined to not be applicable when evaluating the RCAS program.

RCAS uses a forms-based approach for electronic processing of government standard forms. RCAS philosophy is that this approach minimizes training in the user environment. This forms-based approach may be applicable in other functional areas where there is a need for automated processing of standard forms.

RCAS uses Ada as the application development language. Since Ada is a CIM standard, porting the RCAS Ada code should not pose serious problems.

4.1.3 RCAS Economic Analysis. The savings identified in the RCAS BA are based primarily on cost avoidance and cost savings accrued through improved efficiencies in processing, staffing, copying, and transmitting forms. This is supported by the basic RCAS application user interface, which is an on-screen graphic representation of the form on which the soldier, requiring little or no training or interpretation, enters the information.

In calculating the cost avoidance and cost savings in the RCAS BA, it was determined that the efficiencies should be "time-streamed" according to the fielding plans. This was reflected in the benefits-by-year tables and reflected a payback on the project no later than FY 95. Additionally, the first month after installation of RCAS in a unit, it was assumed that no benefit would accrue to the unit during the learning and familiarization period. This ensured a conservative estimate of benefits.

For applications whose functional requirements closely match those of the RCAS, similar savings levels per unit of work should be seen. As applications' functional requirements deviate from those of the RCAS, the RCAS BA model becomes unusable. For applications that do not closely match RCAS functions, a detailed risk-adjusted Functional Economic Analysis would be necessary to quantify benefits.

4.2 JCALS Findings

After analyzing the results of JCALS evaluation efforts, the following general findings and conclusions were developed concerning the JCALS systems architecture. The general findings and conclusions on the JCALS systems architecture are provided below, and specific conclusions for the functional areas analyzed are provided in the following subsections.

The JCALS systems architecture is a well-founded and comprehensive open systems, standards-based architectural model. In addition to rules and guidelines, the systems architecture is composed of the following key subsystems:

- Network. The network subsystem is a three-tiered structure that involves regional, organizational, and user functions. Regional network processing involves monitoring and evaluating the entire JCALS network. The organization tier involves, among other functions, connecting LANs and WANs. The user tier deals with user-level functions, which connect, retrieve, and process information off the network.

- o Workstation Servers. Workstation servers contain the JCALS executable modules, which may be replicated and distributed among several servers.

- o Data Management Processor. The DMP server contains the DBMS COTS system software, which interoperates with the Global Data Base Management System (GDMS).

- o Workstation Clients. The workstation clients are the GDMS client and the user interface client.

4.2.1 Client-Server Findings. The following JCALS findings are relative to its client-server architecture

The main client-server component of JCALS is the GDMS, which comprises three subcomponents:

- o Global Transaction Management System (GTMS)
- o Global Data Dictionary System (GDDS)
- o Local Data Management System (LDMS).

These subcomponents are hosted on the Data Management Processor, and the various JCALS client processes run on client workstations. The components of the GDMS act as both clients and servers to one another but as servers to the workstation client processes. Clients and servers communicate through the UNIX domain sockets.

The LDMS coordinates all requirements for local processor services. It provides data management services support for accessing local Relational Data Base Management Systems (RDMSs), text data bases, UNIX data bases, and some "C" interface routines.

The GDMS will bridge local and remote sites. Once the GDMS server is activated, it accepts socket connections from client applications and other GDMS servers/clients. Each socket connection is either a local request or a remote transaction request. The GDMS will query the GDDS module for location information, priorities, data triggers, constraints, and security information. Once the source/destination of the data is located, GDMS transactions are created, scheduled, and dispatched to either the LDMS running locally or to other GDMS servers/clients executing at remote sites.

GDMS provides for data integrity via a Global Data Integrity component, which includes two-phase commit logic. The two-phase commit process involves determining if requested data elements are currently being used (Phase 1) and, if not, locking those elements and committing the update (Phase 2). The GDMS, together with the LDMS, returns data to the requesting client applications through a front-end X Windows/MOTIF GUI.

These findings are synopsized below:

- The user interface application is based on X Windows/MOTIF.

- The basic architecture of the JCALS data/application system is based on the client-server paradigm (with GDMS components acting primarily as servers) using a UNIX sockets IPC.

- Both COTS and non-COTS components make up the data system, with the non-COTS GDMS acting as a distributed DBMS.

- The COTS SQL-compliant RDBMS and the operating system employed are B1-certified. The operating system is POSIX-compliant, and most of the code is written in Ada, which is consistent with portability requirements of the CIM Directive.

- JCALS will interconnect to 245 JCALS sites.

- Each JCALS site has a data system consisting of RDBMS, UNIX system files, and a text DBMS.

4.2.2 User Interface Findings. Most of the conclusions regarding the JCALS user interface methodology are based on the review of the results of JCALS' compliance with the DoD HCI Style Guide and adherence to the DoD TRM. These results are shown in appendix D of this report. The following additional conclusions were developed as a result of the JCALS demonstration in November 1992:

- JCALS had over a 90 percent compliance rate for user interface requirements where sufficient information was available to make an assessment.

- The JCALS user interface is based on an OSF/MOTIF approach.

- DoD HCI Style Guide requirements addressing an OPEN LOOK approach to a user interface were determined to not be applicable when evaluating the JCALS program.

APPENDIX A

RCAS COMPLIANCE WITH DoD TRM SUMMARY MATRIX

APPENDIX A

RCAS COMPLIANCE WITH DoD TRM SUMMARY MATRIX

Service Category	Service	DoD TRM Section #	Name/Description of Standard	Yes	No	NA	Comments
Programming	Languages	3.3.1.1	The Ada programminglanguage will be used for all DoD systems development	X			Verify by Demo.
	CASE Tools and Environment	3.3.1.2	See comments field				Standard is expected to be identified in the next few years.
User Interface	Client-Server Operations	3.3.2.1	FIPS PUB 158 includes the following specifications:				
			X Window System Protocol, X Version 11	X			Page 3-9 (Software Subsystem Specification)
			Xlib - C language X Interface				SEE NOTE 1
			X Toolkit Intrinsic				SEE NOTE 1
			Bitmap Distribution Format 2.1				SEE NOTE 1
	Object Definition and Management	3.3.2.2	The DoD Human Computer Interface (HCI) Style Guide	X			Page 3-9 (Software Subsystem Specification)
	Window Management	3.3.2.1	FIPS PUB 158, X Window System	X			•
	Dialog Support	3.3.2.2	See comments field				Standard is expected to be identified in the next few years.
Data Management	Data Dictionary/Directory	3.3.3.1	FIPS PUB 156, Information Resource Dictionary System (IRDS)				SEE NOTE 1
	Data Base Management System (DBMS)	3.3.3.2	FIPS PUB 127-1, Structured Query Language (SQL)	X			Page 3-20 (Software Subsystem Specification)
	Distributed Data	3.3.3.3	Draft ISO standard Remote Data Access (RDA)			X	

Service Category	Service	DoD TRM Section #	Name/Description of Standard	Yes	No	NA	Comments
Data Interchange	Document Interchange	3.3.4.1	Planned FIPS PUB (Office Document Architecture/Office Document Interchange Format/OfficeDocument Language ODA/ODIF/ODL			X	
	Document Interchange	3.3.4.2	FIPS PUB 152, Standard Generalized Markup Language (SGML)				SEE NOTE 1
	Vector Graphics	3.3.4.3	FIPS PUB 128, Computer Graphics Metafile (CGM)				SEE NOTE 1
	Raster Graphics	3.3.4.4	FIPS PUB 150, Raster graphics representation in binary format type I&II				SEE NOTE 1
	Product Data Interchange	3.3.4.5	Planned FIPS PUB for Initial Graphics Exchange Specification (IGES)			X	
	Product Data Interchange	3.3.4.6	Draft international standard (standard for the change of product model data step)			X	
	Electronic Data Interchange	3.3.4.7	FIPS PUB 161				SEE NOTE 1
Network Service	Data Communication	3.3.3.1	IRS PUB 146-1 (GOSIP)	X			Telecom. Subsystem Spec. (Page 2-2)
	Transparent File Access		Draft IEEE Standard P1003.8			X	
	Distributed Computing		Draft USF Specification (NCR/PRC)			X	
	Security		ISO 7498-2			X	
	Security		Draft IEEE Standard 802.10			X	
	Security		DNSIX Version 2.3			X	
	Security		Draft ISO Standard for Transport Layer Security Protocol (TLSP)			X	
	Security		ISO Committee Draft for Network Layer Security Protocol (NLSP)			X	

Service Category	Service	DoD TRM Section #	Name/Description of Standard	Yes	No	NA	Comments
Security	Evaluation Criteria		DoD Trusted Computer System Evaluation Criteria (DoD 5200.28.S-TD)	X			Evaluated at B1 level or trust (Page 3-30 Software Subsystem Specification)
	Compartmented Mode Work-station (CMW)		DRS-2600-5502-87	X			Require results of DIA Evaluation (Page 3-30 Software Subsystem Specification). Security Requirements are met by RCAS use of MAXSIX (Telecommunicaticns Subsystem Specification P. 3-59).
	CMW Evaluation Criteria		DRS-2600-6243-91, Version 1	X			*
	CMW Labeling: Encoding Format		DDS-2600-6216-91	X			*
	CMW Labeling: Source code and user interface guidelines.		DDS-2600-6216-91	X			*

NOTE 1: Insufficient documentation was available during the evaluation process to assess RCAS compliance.

APPENDIX B

RCAS COMPLIANCE WITH DoD HCI STYLE GUIDE SUMMARY MATRIX

APPENDIX B

RCAS COMPLIANCE WITH DoD HCI STYLE GUIDE SUMMARY MATRIX

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
Input Devices	3.1	**Provides Pointing Device(s)**, i.e., Mouse, Trackball, Tablet, or Light Pen, to allow users to navigate rapidly around the screen and to specify and select objects for manipulation and action.	X			P3-1 Software Subsystem Specification (SSS).
	3.1.1	**Mouse Button Definitions:**				RCAS use 3-button mouse. P. 3-8 (SSS).
		o Press - Hold mouse button down.	X			Verify by Demo.
		o Release - Let up on the mouse button.	X			•
		o Click - A quick push and release of the mouse button.	X			•
		o Double-Click - Two quick clicks on mouse.	X			•
		o Move - Slide the pointer without pressing buttons.	X			•
		o Drag - Slide the pointer while holding button down.	X			•
	3.1.2	**The Pointer:** Objects on the screen can be manipulated by positioning the pointer over the object and pressing the mouse buttons appropriately. The user moves the pointer by moving the mouse on the mouse pad. Different actions are used to move other pointing devices (e.g., trackballs, light pens).				
		o Mouse pointer shapes provide clues to activity within a window, i.e., an hour glass or watch shaped pointer indicates an application is busy.	X			Verify by Demo.
		o The pointer remains where it is placed until moved by the application or the user.	X			•
		o The pointer does not drift.	X			•
		o Mouse button definitions (three buttons to support MOTIF).	X			P. 3-9 (SSS)

CATEGORY	DoD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		- Indicate function of each button (i.e., select, drag, adjust, menu, custom).				
		button (1) Select Application	X			Verify by Demo.
		button (2) Select valid fields values	X			"
		button (3) Help	X			"
	3.2	**Keyboard:** Should be virtually interchangeable with the pointing device, i.e., functions should not be solely available through a function key.	X			Verify by Demo.
	3.3	**Input Focus:** Windows with input focus (actively selected and waiting for input) should be identified in a consistent manner.				
		o Is window at front of work space?	X			Verify by Demo.
		o Is window highlighted in some fashion (e.g., window frame, title bar)?	X			"
		o Is the user able to enter input?	X			"
Basic Screen Guidelines	4.1	**Workstation Login:** Should be developed for each application.	X			P4-2 (SSS)
		Screen saver, with minute inactivity timer, is recommended.	X			"
	4.2	**Application Login:** For systems that do not support a unitary login, a separate authentication process (additional login) should be displayed.	X			P4-10 (SSS)
	4.3	**Application Logoff:** Exits an application and closes all windows associated with the application. If other windows are open, the next window on the window stack should be uncovered; otherwise, the resource manager should become visible.	X			P4-12 (SSS)
		o Is the application logoff accomplished by selecting the exit function?	X			"
		o Is user asked to save changes that are not saved when exiting?	X			"
	4.4	**Workstation Logoff:** Closes all application windows and returns to initial workstation login screen. An exit is initiated for all active applications.	X			"

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	N/A	COMMENTS
	4.5	**Resource Manager Capabilities and Basic Screen Guidelines:** When the user successfully completes the workstation Log-in and is granted access to system resources, the resource manager window should be displayed on the screen.	X			P. 4-7 (SSS)
	4.5.1	**Resource Manager:** The resource manager is the entity that provides access to workstation resources and utilities. It should present only those functions and applications that a particular user is allowed to access.	X			Uniplex Application Window p4-8 (SSS). RCAS Mission Support Window.
		o Program accesses.	X			•
		o Window snapshots (print screen).	X			•
		o Access to common applications (e.g., word processor, spreadsheet).	X			•
		o User preference/customized (e.g., left or right-handed mouse).	X			•
		o Utilities (e.g., calculator, calendar, clock/alarm,note pad, mail).	X			•
		o Display of system and workstation messages (error and status).	X			•
		o End session/log user out of account.	X			•
		o Work file maintenance.	X			
		o System-level help.	X			•
		o Security functions for authorized persons.	X			P4-47 (SSS).
	4.5.2	**Resource Manager Menu:** Should contain, as a minimum,menus for applications that the user is allowed to access and help.	X			P. 4-12 (SSS).
		o If multisystem access is required to retrieve data sets, is the application able to find the data on different systems?			X	
	4.5.3	**Icons:** A graphic representing a window closed while the application is still active. The icon title should default to the same title as the application or an appropriate abbreviation.	X			P. 4-10 (SSS).
General Window Functions	5.1	**Basic Window Appearance:** The Bottom line of the base window area is called the message area.	X			P. 4-5 (SSS).

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	5.1.1	**Title Bar:**				
		o MOTIF title bar displays the window title, the Window Menu button, the Minimize button, and the Maximize button.	X			P. 3-19 (SSS).
		o OPEN LOOK title bar displays the window title and the Window Menu button.			X	
	5.1.1.1	**Title:** Clearly identifies the application to the user.				
		o Title should contain the name of the application, followed by a colon, followed by the name of the currently displayed file or menu (e.g., Editor.Myfile.txt).				SEE NOTE 1
		o Title should be centered.				"
		o Title should be distinguished by a visual attribute (e.g., boldface type).				"
		o Base window of an application (sometimes called a primary or main window) should be identified as such through the title (e.g., Trusted Path:Main Menu).	X			Page 4-18 Software Subsystem Specification.
		o Secondary windows should identify the application and the window's function (e.g., Trusted Path:Authorization Menu ISSO).	X			"
		o A window's title may display the version number of the application, but should not display messages.				SEE NOTE 1
	5.1.1.2	**The Window Menu Button:** Located in the upper left corner of the title bar. Provides a standard location for window management functions (e.g., close, move, and window resizing functions).	X			P. 4-12 (SSS).
	5.1.1.3	**Reducing the Window to an Icon:** Inactive windows, or windows not requiring user attention, can be reduced to icons. Application processing then continues in the background.				
		o OSF/MOTIF - Select Minimize button from title bar, select Minimize function from window menu bar, or press Minimize accelerator keys.				SEE NOTE 1
		o OPEN LOOK - Select Close function in base window menu.			X	

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	5.1.1.4	**Expanding a Window to its Full Size:** Windows can be expanded by dragging the resize borders or corners.				
		o *OSF/MOTIF* - Select Maximize button from title bar, select Maximize function from Window Menu button, or press Maximize accelerator keys.	X			Page 3-32 Software Subsystem Specification.
		o OPEN LOOK - Use of the base window menu.			X	
	5.1.2	**Dragging the Window:** Moves the window to a different location on the screen. A "ghost" outline of the window should move with the pointer. The window should move to the position of the pointer when mouse button is released.				
		o MOTIF - Position mouse pointer over title area of title bar, press Select button, move mouse pointer to desired location, and release Select button.	X			P. 3-19 (SSS).
		o OPEN LOOK - Drag any part of the window that is not covered by a control, pushpin, or scroll bar; use move option from Window Menu button, or use appropriate keyboard function key.			X	
	5.1.3	**Scroll Bars:** Allow user to view through objects that are too long or wide to be displayed in the application area.				
		o Vertical scroll bars - Located at right edge of the screen; support backward/forward movement.	X			P. 4-8 (SSS).
		o Horizontal scroll bars - Located at bottom of screen; support left/rightmovement.	X			
	5.1.4	**Application Area:** The area where the application is displayed and users perform work.	X			P. 4-10 (SSS).
	5.1.5	**Message Area:** Reserved for messages that do not suspend processing.				
		o Left side of area is reserved for short-term messages.				SEE NOTE 1
		o Right side of area is reserved for medium-term messages.				SEE NOTE 1

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	5.1.6	**Resizing the Window:** Increases or decreases the size of the window frame.				
		o Minimum height - Allows room for classification bar, title bar, and menu bar.	X			P. 3-19 (SSS)
		o Is the resize information (which may need to be pulled down) always contained to the upper left corner of the window?	X			•
		o Scalability - Only the size of the window's borders change, not the size or relative position of data within the window.	X			•
		o Distinguishable - Resizeable windows are easily distinguished from windows that cannot be resized.	X			•
	5.2	**Window Menu Bar/Control Area:** Contains list of titles (menu names) of available pull-down menus.				
		o Browsing - Menu name highlights as the pointer is dragged over it and a list of menu items appear directly beneath the name.	X			P. 4-12 (SSS).
		o Disabled Menu Items - Dimmed or grayed and do not highlight when the pointer is dragged over them.	X			•
		o Pull-Down Menus - Contain related functions.	X			•
		o Mnemonics and accelerators are available for keyboard access to menu items, and their existence is visually represented on the menu.	X			•
		o Selecting Menu Items - Requires two actions: identify item to be selected, and select the item.	X			•
		o Deselecting Menu Items - Move the pointer to another item or outside the menu.	X			•
	5.2.1	**Menu Entries:** Can be one of three primary types: An action item, a routing, or a setting.	X			•
	5.2.1.1	**Action and Command Menu Entries** executes the function named in the main menu item.	X			PP 4-13, 4-14, 4-15, 4-16 (SSS)

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	5.2.1.2	**Routing, Window Items, and Menu Items**				
		o When selected, display other windows or menus.	X			PP 4-13, 4-14, 4-15, 4-16 (SSS).
		o Display windows are designated by displaying continuation characters ("...") after the menu entry.	X			▪
		o Submenus are designated by displaying a pointer (e.g., "→") or hcllow triangle after the menu entry.	X			▪
	5.2.1.3	**Settings:** Used to set an application state.				
		o MOTIF - Displayed as check buttons (for non-exclusive settings) or radio buttons (for mutually exclusive settings).	X			PP 4-13, 4-14, 4-15, 4-16 (SSS).
		o OPEN LOOK - Exclusive settings displayed as touching rectangles, non-exclusive settings displayed using separate rectangles or check boxes.			X	
	5.2.2	**Mnemonics and Accelerators:** A mnemonic is a single character shortcut for making a menu selection from the keyboard. Keyboard accelerators are multiple key sequences that invoke a menu item without displaying the menu.				
		o Usually the first letter of a menu item.				SEE NOTE 1
		o ~~Unique within the window with input focus.~~				▪
		o Used for frequently used functions.				▪
		o Mnemonics and accelerators should not be case-sensitive.				▪
		o Mnemonics should be :nderlined and/or designated in bold on contrasting color.				▪
		o Only accessible when the menu containing them is displayed.				▪
		o Keyboard accelerator appears right-justified on the same line as the menu item.				▪

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	5.2.3	**Menu Item Selection With Mouse**				
		o Method 1 - Position the pointer on the menu option, press appropriate mouse button, drag the pointer to the desired option, and release the mouse button.	X			Verify by Demo.
		o Method 2 - Move the pointer to the menu option and click the appropriate mouse button. Move the pointer to the desired option and click the mouse button again.	X			"
	5.2.4	**Menu Item Selection Without Mouse:** Arrow keys can position the pointer on a menu item and press the Return/Enter key to select the item.	X			"
		o ESC key used to cancel menu without choosing an option.			X	
	5.3	**Window Controls:** Mimic (through switches or buttons) the physical items they represent by providing feedback before, during, and after selection by a user (e.g., button appears pushed when selected).				
		o Keyboard has equivalent functionality.	X			Verify by Demo.
		o Mnemonics provided for each control.				SEE NOTE 1
	5.3.1	**Check Buttons/Non-Exclusive Settings:** Physical toggle switch.				
		o User should be able to toggle them off and on by positioning the pointer over the control and clicking the Select button.	X			Verify by Demo.
		o An empty or raised box indicates the control is off; a filled or depressed box indicates it is on.	X			"
	5.3.2	**Radio Buttons/Exclusive Buttons:** Used when selecting from multiple options where only one can be selected.				
		o MOTIF - At least two buttons and a label that describes the function of the set	X			Verify by Demo.
		o OPEN LOOK - Exclusive settings displayed as touching rectangles.			X	
		o Select by positioning the pointer over the button or rectangle and clicking the Select button.	X			"

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS*
		o The previously selected control is deselected.	X			Verify by Demo.
		o An empty or raised butto‹ indicates control is off; a filled or depressed button indicates it is on.				SEE NOTE 1
	5.3.3	**Pushbuttons/Command Buttons:**				
		o Consists of a name or icon within a rectangle or oval frame.				SEE NOTE 1
		o Select the control by positioning the pointer over it and pressing the Select button.	X			Verify by Demo.
		o Releasing the Select button executes the action.	X			•
		o Default pushbutton should always be provided.				SEE NOTE 1
	5.3.4	**Text Fields:**				
		o Title or label appended to the field to ident‴ the data to be entered.				SEE NOTE 1
		o Text display scrolls horizontally if text entered longer than input areas.	X			
		o Text entered more than one line high, entry area should scroll vertically.	X			
		o Title describes what is to be entered and appears to the left or above the entry area.				SEE NOTE 1
	5.4	**Button Definitions:** Standard vocabulary to be used in applications.				SEE NOTE 1
	5.5	**Window Colors/Patterns/Audio Signals:**				
		o Background patterns used to highlight group, clarify relationships, and add meaning.	X			Verify by Demo.
		o Color not provided as the only means of visual distinction.	X			•
		o User-selectable color schemes.	X			•
		o Common colcr meanings used.				
		- red: stop, alarms, errors, danger, critical consequences				SEE NOTE 1
		- yellow: warning, caution, approaching critical				SEE NOTE 1

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		- green: normal, safe, within normal range, proceed				SEE NOTE 1
		- blue: cold, water, non-critical items				SEE NOTE 1
		- gray: inactive, unavailable				SEE NOTE 1
		o Critical messages use continuous audio tone and the color red until user responds. Non-critical messages use yellow and a short audio alert.			X	
		o Colors used do not cause eye strain.			X	
		o Same color scheme for all windows of an application.			X	
		o Application window background is in enough contrast with foreground to stand out options or actions.			X	
		o Both color and sound should used for messages that require user acknowledgement.				SEE NOTE 1
		o Critical messages displayed in red, and the audio alarm continues until the user responds.				SEE NOTE 1
		o Non-critical messages displayed in yellow, accompanied by a short audio alert.			X	
		o Spectral extremes (e.g., red and green).				SEE NOTE 1
Dialog Boxes/ Pop-Up Windows	6.1	**Message Wording Guidelines:** Applies to dialog boxes, pop-up windows, message areas, and any other communications between the application and user.				
		o Abbreviations are only used when significantly shorter than full word.	X			P. 4-10, 4-5 (SSS).
		o Abbreviations are meaningful, recognizable, and used consistently.	X			•
		o Words that are not commonly abbreviated should not be abbreviated.	X			•
		o Message lines end in full words rather than hyphenations.	X			•
		o Messages are directly usable, requiring no further documentation or translation.	X			•
		o Overly technical wording is avoided.	X			•

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o Abrupt wording is avoided (e.g., INVALID, ILLEGAL, FATAL).	X			•
		o Error messages focus on the procedure for correcting, not action that caused the error.	X			•
		o Critical error messages are contained in caution/ warning windows.	X			•
		o Non-critical messages are displayed in the message area at the bottom of the application window.	X			•
	6.2	Work In Progress Window:				
		o Feedback (for response time of 5 or less seconds) is in the form of a changed pointer shape or brief message within window.	X			Verify by Demo.
		o For response time exceeding RCAS requirement, a work in progress window is provided to indicate time-consuming operation and provide a means by which the operation can be canceled or aborted.	X			•
	6.3	Information Box: Reserved for non-critical messages requiring acknowledgement by the user.				
		o Frequent informational messages are displayed in the window's message area.	X			P. 4-10, 4-5 (SSS).
		o An information box can freeze application until user dismisses it.	X			•
		o "Retry" button should be included if halted operation can be retried.			X	
	6.4	Caution/Warning Box:				
		o Contains critical messages that warn the user.	X			P. 4-10, 4-5 (SSS).
		o Usually contains Yes, No, and Cancel buttons.				SEE NOTE 1
		o Application is suspended until the user provides instructions on how to proceed.	X			P. 4-10, 4-5 (SSS).
		o Message should be unambiguous question or statement.	X			•
		o The default pushbutton should always be the least destructive.			X	

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	6.5	**Menu Box:** Solicits data from users through a combination of controls.				
		o Menu box should be named in accordance with the menu item that created it.				SEE NOTE 1
		o Cancel button included.				SEE NOTE 1
		o If a default push button is designated, it should be the assumed desired action.				SEE NOTE 1
Common Features	7.1	**Date/Time Display:**				
		o Format is YYMMDD for date.	X			Consistent with format required by specific form.
		o Format is HHMM{SS}Z for time.	X			
		o Date/Time Group should be displayed as DDHHMMZ MMM YY.	X			
	7.2	**Latitude/Longitude Display:** Always given as two fields with optional labels (Lat, Long).				
		o Latitude - d{d}hOR dd{mm{ss}}h				SEE NOTE 1
		o Longitude - D{D{D}}Hor DDD{MM{SS}}H				SEE NOTE 1
	7.3	**Help Features:**				
		o Context-sensitive help describes the purpose of the item and how to interact with the item.	X			P. 4-40, 4-41 (SSS).
		o Help for abbreviated label entry fields abbreviated or acronyms should include long, unabbreviated name and a definition.	X			•
		o Help is included as a menu title in window menu bar (control area).	X			•
		o The keyboard Help key and F1 function key are used to access help.	X			•
		o The title of a help window should reflect its contents.	X			•
		o Help is easily accessed and exited.	X			•
		o A single response is all that is required.	X			•

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o The help window is placed in the position that covers the least amount of information in the active application window.	X			
	7.4	**User-Definable Parameters:**				
		o Users should be able to select map colors from a color palette.	X			
		o Users should not be allowed to change security banner colors.	X			
		o Users should be able to specify the printer destination.	X			
		o Mouse button function mappings -- users should be able to specify left-hand or right-hand button configurations.	X			
		o Experienced users may bypass help messages.	X			
		o Any changes are immediatelyreflected in a sample item displayed within the selection window.			X	
	7.5	**Wild Card Characters:**				
		o '@' replaces any single alphabetic character (not case- sensitive).	X			
		o '#' replaces any single numeric character (not case-sensitive).	X			
		o '?' replaces any single alphanumeric character (not case-sensitive).	X			
		o '*' replaces zero or more alphanumeric characters.	X			
Text Windows	8.1	**Data Field Labeling:**				
		o Displays should not be different from paper forms without justification.	X			
		o The layout of commonly used displays is consistent across all applications.	X			
		o Data field labels are easily distinguishable from the data itself.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o Columnar data should be distinctly separated (at least three spaces between columns) with column headings displayed above the data. One row of separation between the column heading and the data.	X			
		o Labels should be consistent throughout an application or set of applications.	X			
		o Field labels should be protected and transparent to keyboard control so that the cursor skips over them when tabbing or spacing.	X			
		o Dimensional units always associated with a field are displayed as part of the label and not required for entry by the user.				SEE NOTE 1
	8.2	**Update Fields:**				
		o Updatable fields should be distinguished by underscores below the data field.				SEE NOTE 1
		o Cues distinguish optional from required fields and are consistent throughout application.	X			
		o The user should not need to right- or left-justify, or remove blanks from, the entered data in variable-length fields.	X			
		o The user should be able to enter data in familiar units.	X			
		o Application should perform any required conversions.				SEE NOTE 1
		o Authorized personnel are able to selectively inhibit updatable fields in a multifield display.				SEE NOTE 1
		o If colors or highlights are used, they should be consistent throughout the application.			X	
	8.3	**Text Cursor:**				
		o If the user clicks on a non-updatable field, the text cursor should not move.				SEE NOTE 1
		o The text cursor should move between and within fields with the mouse or by using the Return/Entry key, the Tab key, or the arrow keys.	X			Verify by Demo.
		o The cursor should not obscure the character displayed in the position it designates.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o In insert mode, the text cursor should appear between the characters where the inserted text will be placed.				SEE NOTE 1
		o In overwrite mode, the text cursor should highlight the character that will be replaced.				•
Graphics Windows	9.1	**Data Display:** All maps should be north oriented, or the north direction should be annotated.				SEE NOTE 1
	9.2	**Item Selection:** Guidelines for item selection on a map graphics screen.				
		o The cursor should include a point designation feature (e.g., cross-hairs or a v-shaped symbol).	X			P. 3-9 (SSS)
		o The user is able to select a single item within a densely packed group. When selected, the item should be highlighted.	X			•
	9.3	**Interaction with Data/Items:** Functions are available through menus to permit the user to make measurements, perform analysis, and control the appearance.				SEE NOTE 1
	9.3.1	**Zoom-In:** Permits the user to magnify a portion of the graphics canvas.				
		o Includes reference display that indicates relative position of the area viewed within the original canvas.	X			P. 3-9 (SSS)
	9.3.2	**Zoom-Out:** Rescales the display by permitting the user to return to the previous zoom level and position.	X			•
	9.3.3	**Full Zoom-Out:** Displays the lowest scale map.				SEE NOTE 1
	9.3.4	**Distance/Azimuth:**				
		o Calculates the distance (range) and azimuth (bearing) between any two selectable points or symbols.				SEE NOTE 1
		o Distance is presented in selectable units.				SEE NOTE 1
		o Azimuth is displayed in degrees from true north.				SEE NOTE 1
	9.3.5	**Determine Position:** Calculates the position of the point identified by a starting latitude and longitude, distance (in nautical miles), and azimuth.				
		o Answer provided textually.				SEE NOTE 1

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o Coordinates presented in a selectable coordinate system.				SEE NOTE 1
	9.3.6	**Clear Selection:** Deselects a selected graphics item.				SEE NOTE 1
	9.3.7	**Current Selection Location:** Returns the geographic coordinates of the selected graphics item.				SEE NOTE 1
	9.3.8	**Legend:** Opens/closes a panel that displays the symbols and corresponding textual titles available for an application.				SEE NOTE 1
	9.3.9	**Map Overlay Editor:** Activates/deactivates a map overlay editor application.				SEE NOTE 1
	9.3.10	**Overlay Options:**				
		o Capable of displaying a list of available overlays, distinguishing between visible and invisible overlays.				SEE NOTE 1
		o Possible overlays include boundary lines, oceans, rivers, grids, masses, railways, and user-generated overlays.				SEE NOTE 1
	9.3.11	**Graphics Symbols, Line Types, and Colors:** Colors, symbols, line size/quality, and fonts should be consistent throughout a given system.				
		o Whenever possible, display symbology should conform with published standards (e.g., Army field manual 101-5-1, NATO standardization Agreement 2019, or DIA standard militarygraphics manual).			X	
		o Each system should be able to use a commercial graphics editor to accommodate the creation display of system-unique features and symbols.			X	
	9.3.12	**Area Bounding Boxes:** Pairs of coordinates defining a rectangular area in terms of latitude and longitude.				
		o Should be used when displaying maps.				SEE NOTE 1
		o Displays the bounding coordinates for the geographic area being shown.				SEE NOTE 1

NOTE 1: Insufficient documentation was available during the evaluation process to assess RCAS compliance.

APPENDIX C

JCALS COMPLIANCE WITH DoD TRM SUMMARY MATRIX

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JCALS COMPLIANCE WITH DoD TRM SUMMARY MATRIX

Service Category	Service	DoD TRM Section #	Name/Description of Standard	Yes	No	NA	Comments
Programming	Languages	3.3.1.1	The Ada programminglanguage will be used for all DoD systems development.	X			Ada will be the preferred programminglanguage when developing non-COTS support software. F.D JCALS (Page 5-17)
	CASE Tools and Environment	3.3.1.2	See comments field	X			No Standard
User Interface	Client-Server Operations	3.3.2.1	FIPS PUB 158 includes the following specifications:				
			X Window System Protocol, X Version 11	X			Hardware Architecture Configuration Document (Page 1-3).
			Xlib - C language X Interface	X			
			X Toolkit Intrinsic	X			
			Bitmap Distribution Format 2.1	X			
	Object Definition and Management	3.3.2.2	The DoD Human Computer Interface (HCI) Style Guide	X			F.D JCALS (Page 5-20)
	Window Management	3.3.2.1	FIPS PUB 158, X Window System	X			Motif F.D JCALS (Page 5-21)
	Dialog Support	3.3.2.2	See comments field			X	Has been requested not added yet.
Data Management	Data Dictionary/Directory	3.3.3.1	FIPS PUB 156, Information Resource Dictionary System (IRDS)	X			IRDS is a subset of JCALS data models.
	Data Base Management System (DBMS)	3.3.3.2	FIPS PUB 127-1, Structured Query Language (SQL)	X			GDMS interface accepts SQL.
	Distributed Data	3.3.3.3	Draft ISO standard Remote Data Access (RDA)	X			Distributed and handled by GDMS.

Service Category	Service	DoD TRM Section #	Name/Description of Standard	Yes	No	NA	Comments
Data Interchange	Document Interchange	3.3.4.1	Planned FIPS PUB (Office Document Architecture/Office Document Interchange Format/OfficeDocument Language ODA/ODIF/ODL		X		Not JCAL Standard.
	Document Interchange	3.3.4.2	FIPS PUB 152, Standard Generalized Markup Language (SGML)	X			F.D JCALS (Page 5-22)
	Vector Graphics	3.3.4.3	FIPS PUB 128, Computer Graphics Metafile (CGM)	X			F.D JCALS (Page 5-22)
	Raster Graphics	3.3.4.4	FIPS PUB 150, Raster graphics representation in binary format type I&II	X			F.D JCALS (Page 5-22)
	Product Data Interchange	3.3.4.5	Planned FIPS PUB for Initial Graphics Exchange Specification (IGES)	X			F.D JCALS (Page 5-22)
	Product Data Interchange	3.3.4.6	Draft international standard (standard for the change of product model data step)				Product data exchange standard PDES is an evolving standard. JCALS will incorporate PDES when available.
	Electronic Data Interchange	3.3.4.7	FIPS PUB 161				SEE NOTE 1
Network Service	Data Communication	3.3.6.1	IRS PUB 146-1 (GOSIP)	X			F.D JCALS (Page 5-22)
	Transparent File Access		Draft IEEE Standard P1003.8	X			No following standard
	Distributed Computing		Draft USF Specification (NCR/PRC)				SEE NOTE 1. Incorporate when available.
	Security		ISO 7498-2				Evolving standard
	Security		Draft IEEE Standard 802.10				•
	Security		DNSIX Version 2.3				Targeting DNSIX 3.0
	Security		Draft ISO Standard for Transport Layer Security Protocol (TLSP)				Evolving standard
	Security		ISO Committee Draft for Network Layer Security Protocol (NLSP)				•

Service Category	Service	DoD TRM Section #	Name/Description of Standard	Yes	No	NA	Comments
Security	Evaluation Criteria		DoD Trusted Computer System Evaluation Criteria (DoD 5200.28.S-TD)	X			Evaluated at B1 level or trust (Page 5-17 F.D JCALS)
	Compartmented Mode Workstation (CMW)		DRS-2600-5502-87	X			
	CMW Evaluation Criteria		DRS-2600-6243-91, Version 1	X			
	CMW Labeling: Source Code and User Interface Guidelines		DDS-2600-6216-91	X			
	CMW Labeling: Encoding Format		DDS-2600-6216-91	X			

NOTE 1: Insufficient documentation was available during the evaluation process to assess JCALS compliance.

APPENDIX D

JCALS COMPLIANCE WITH
DoD HCI STYLE GUIDE SUMMARY MATRIX

APPENDIX D

JCALS COMPLIANCE WITH DoD HCI STYLE GUIDE SUMMARY MATRIX

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
Input Devices	3.1	Provides Pointing Device(s), i.e., Mouse, Trackball, Tablet, or Light Pen, to allow users to navigate rapidly around the screen and to specify and select objects for manipulation and action.	X			Page 4 CALS HCI
	3.1.1	Mouse Button Definitions:				
		o Press - Hold mouse button down.	X			Page 5 CALS HCI.
		o Release - Let up on the mouse button.	X			•
		o Click - A quick push and release of the mouse button.	X			•
		o Double-Click - Two quick clicks on mouse.	X			Page 6 CALS HCI
		o Move - Slide the pointer without pressing buttons.	X			Page 5 CALS HCI
		o Drag - Slide the pointer while holding button down	X			Page 6 CALS HCI
	3.1.2	The Pointer: Objects on the screen can be manipulated by positioning the pointer over the object and pressing the mouse buttons appropriately. The user moves the pointer by moving the mouse on the mouse pad. Different actions are used to move other pointing devices (e.g., trackballs, light pens).				
		o Mouse pointer shapes provide clues to activity within a window, i.e., an hour glass or watch shaped pointer indicates an application is busy.	X			Page 7 CALS HCI
		o The pointer remains where it is placed until moved by the application or the user.	X			•
		o The pointer does not drift.	X			•
		o Mouse button definitions (three buttons to support MOTIF).	X			Page 6 CALS HCI

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		- Indicate function of each button (i.e., select, drag, adjust, menu, custom). button (1) Select Application button (2) Select valid fields values button (3) Help				
	3.2	**Keyboard:** Should be virtually interchangeable with the pointing device, i.e., functions should not be solely available through a function key.	X			Page 6 CALS HCI
	3.3	**Input Focus:** Windows with input focus (actively selected and waiting for input) should be identified in a consistent manner.				
		o Is window at front of work space?	X			Page 9 CALS HCI
		o Is window highlighted in some fashion (e.g., window frame, title bar)?	X			Page 10 CALS HCI
		o Is the user able to enter input?	X			
Basic Screen Guidelines	4.1	**Workstation Login:** Should be developed for each application.	X			Unitary log-in provides access to all authorized applications.
		Screen saver, with minute inactivity timer, is recommended.	X			
	4.2	**Application Login:** For systems that do not support a unitary login, a separate authentication process (additional login) should be displayed.	X			Planning unitary login.
	4.3	**Application Logoff:** Exits an application and closes all windows associated with the application. If other windows are open, the next window on the window stack should be uncovered; otherwise, the resource manager should become visible.				
		o Is the application logoff accomplished by selecting the exit function?	X			
		o Is user asked to save changes that are not saved when exiting?	X			
	4.4	**Workstation Logoff:** Closes all application windows and returns to initial workstation login screen. An exit is initiated for all active applications.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	4.5	**Resource Manager Capabilities and Basic Screen Guidelines:**				
	4.5.1	**Resource Manager:** The resource manager is the entity that provides access to workstation resources and utilities. It should present only those functions and applications that a particular user is allowed to access.				
		o Program accesses.	X			X. Desktop.
		o Window snapshots (print screen).	X			X. Desktop.
		o Access to common applications (e.g., word processor, spreadsheet).	X			•
		o User preference/customized (e.g., left or right-handed mouse).	X			•
		o Utilities (e.g., calculator, calendar, clock/alarm,note pad, mail).	X			•
		o Display of system and workstation messages (error and status).	X			X. Desktop MLS+/Launch
		o End session/log user out of account.	X			X. Desktop MLS+
		o Work file maintenance.	X			X. Desktop
		o System-level help.	X			X. Deskhelp
		o Security functions for authorized persons.	X			MLS+
	4.5.2	**Resource Manager Menu:** Sho·.d contain, as a minimum,menus for applications that the user is allowed to access and help.				Database handles. Icons on the desktop provide access tc applications.
		o If multisystem access is required to retrieve data sets, is the application able to find the data on different systems?	X			
	4.5.3	**Icons:** A graphic representing a window closed while the application is still active. The icon title should default to the same title as the application or an appropriate abbreviation.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
General Window Functions	5.1	**Basic Window Appearance**				
	5.1.1	**Title Bar:**				
		o MOTIF title bar displays the window title, the Window Menu button, the Minimize button, and the Maximize button.	X			F.D JCALS (Page 5-21)
		o OPEN LOOK title bar displays the window title and the Window Menu button.			X	
	5.1.1.1	**Title:** Clearly identifies the application to the user.				
		o Title should contain the name of the application, followed by a colon, followed by the name of the currently displayed file or menu (e.g., Editor.Myfile.txt).	X*			(X*) Comply when reasonable but many times following the guideline work result in a title to wide for the window.
		o Title should be centered.	X			Cannot always control the format and contents of title used by COTS packages.
		o Title should be distinguished by a visual attribute (e.g., boldface type).	X			
		o Base window of an application (sometimes called a primary or main window) should be identified as such through the title (e.g., Trusted Path:Main Menu).	X*			
		o Secondary windows should identify the application and the window's function (e.g., Trusted Path:Authorization Menu ISSO).	X*			
		o A window's title may display the version number of the application, but should not display messages.	X			
	5.1.1.2	**The Window Menu Button:** Located in the upper left corner of the title bar. Provides a standard location for window management functions (e.g., close, move, and window resizing functions).	X			Page 9, 10 CALS HCI

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	5.1.1.3	**Reducing the Window to an Icon:** Inactive windows, or windows not requiring user attention, can be reduced to icons. Application processing then continues in the background.				
		o OSF/MOTIF - Select Minimize button from title bar, select Minimize function from window menu bar, or press Minimize accelerator keys.	X			•
		o OPEN LOOK - Select Close function in base window menu.			X	
	5.1.1.4	**Expanding a Window to its Full Size:** Windows can be expanded by dragging the resize borders or corners.				
		o OSF/MOTIF - Select Maximize button from title bar, select Maximize function from Window Menu button, or press Maximize accelerator keys.	X			•
		o OPEN LOOK - Use of the base window menu.			X	
	5.1.2	**Dragging the Window:** Moves the window to a different location on the screen. A "ghost" outline of the window should move with the pointer. The window should move to the position of the pointer when mouse button is released.				
		o MOTIF - Position mouse pointer over title area of title bar, press Select button, move mouse pointer to desired location, and release Select button.	X			Page 9, 10 CALS HCI
		o OPEN LOOK - Drag any part of the window that is not covered by a control, pushpin, or scroll bar; use move option from Window Menu button, or use appropriate keyboard function key.			X	
	5.1.3	**Scroll Bars:** Allow user to view through objects that are too long or wide to be displayed in the application area.				
		o Vertical scroll bars - Located at right edge of the screen; support backward/forward movement.	X			
		o Horizontal scroll bars - Located at bottom of screen; support left/rightmovement.	X			
	5.1.4	**Application Area:** The area where the application is displayed and users perform work.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	5.1.5	**Message Area:** Reserved for messages that do not suspend processing.				
		o Left side of area is reserved for short-term messages.	X			
		o Right side of area is reserved for medium-term messages.	X			
	5.1.6	**Resizing the Window:** Increases or decreases the size of the window frame.				
		o Minimum height - Allows room for classification bar, title bar, and menu bar.	X			Page 9,10 CALS HCI
		o Is the resize information (which may need to be pulled down) always contained to the upper left corner of the window?	X			•
		o Scalability - Only the size of the window's borders change, not the size or relative position of data within the window.				Resizable windows are designed to provide the user with an expanded view of the contents. Windows are designed to be scalable only when there is a purpose.
		o Distinguishable - Resizeable windows are easily distinguished from windows that cannot be resized.	X			
	5.2	**Window Menu Bar/Control Area:** Contains list of titles (menu names) of available pull-down menus.				
		o Browsing - Menu name highlights as the pointer is dragged over it and a list of menu items appear directly beneath the name.	X			Page 17,18,19 CALS HCI
		o Disabled Menu Items - Dimmed or grayed and do not highlight when the pointer is dragged over them.	X			•
		o Pull-Down Menus - Contain related functions.	X			•
		o Mnemonics and accelerators are available for keyboard access to menu items, and their existence is visually represented on the menu.	X			•

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o Selecting Menu Items - Requires two actions: identify item to be selected, and select the item.	X			•
		o Deselecting Menu Items - Move the pointer to another item or outside the menu.	X			•
	5.2.1	**Menu Entries**				
	5.2.1.1	**Action and Command Menu Entries** executes the function named in the main menu item.	X			
	5.2.1.2	**Routing, Window Items, and Menu Items**				
		o When selected, display other windows or menus.	X			
		o Display windows are designated by displaying continuation characters ("...") after the menu entry.		X		
		o Submenus are designated by displaying a pointer (e.g., "→") or hollow triangle after the menu entry.	X			
	5.2.1.3	**Settings:** Used to set an application state.				
		o MOTIF - Displayed as check buttons (for non-exclusive settings) or radio buttons (for mutually exclusive settings).	X			
		o OPEN LOOK - Exclusive settings displayed as touching rectangles, non-exclusive settings displayed using separate rectangles or check boxes.			X	
	5.2.2	**Mnemonics and Accelerators:** A mnemonic is a single character shortcut for making a menu selection from the keyboard. Keyboard accelerators are multiple key sequences that invoke a menu item without displaying the menu.				
		o Usually the first letter of a menu item.	X			Page 19 CALS HCI
		o Unique within the window with input focus.	X			•
		o Used for frequently used functions.	X			•
		o Mnemonics and accelerators should not be case-sensitive.	X			•
		o Mnemonics should be underlined and/or designated in bold on contrasting color.	X			•

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o Mnemonics are only accessible when the menu containing them is displayed.	X			Accelerators are accessible all the menu.
		o Keyboard accelerator appears right-justified on the same line as the menu item.	X			
	5.2.3	**Menu Item Selection With Mouse**				
		o Method 1 - Position the pointer on the menu option, press appropriate mouse button, drag the pointer to the desired option, and release the mouse button.	X			
		o Method 2 - Move the pointer to the menu option and click the appropriate mouse button. Move the pointer to the desired option and click the mouse button again.	X			
	5.2.4	**Menu Item Selection Without Mouse:** Arrow keys can position the pointer on a menu item and press the Return/Enter key to select the item.	X			Page 7 CALS HCI
		o ESC key used to cancel menu without choosing an option.	X			
	5.3	**Window Controls:** Mimic (through switches or buttons) the physical items they represent by providing feedback before, during, and after selection by a user (e.g., button appears pushed when selected).				
		o Keyboard has equivalent functionality.	X			Page 19 CALS HCI
		o Mnemonics provided for each control.	X			Menus only
	5.3.1	**Check Buttons/Non-Exclusive Settings:** Physical toggle switch.				
		o User should be able to toggle them off and on by positioning the pointer over the control and clicking the Select button.	X			Page 13,14,15 CALS HCI
		o An empty or raised box indicates the control is off; a filled or depressed box indicates it is on.	X			
	5.3.2	**Radio Buttons/Exclusive Buttons:** Used when selecting from multiple options where only one can be selected.				
		o MOTIF - At least two buttons and a label that describes the function of the set	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o OPEN LOOK - Exclusive settings displayed as touching rectangles.			X	
		o Select by positioning the pointer over the button or rectangle and clicking the Select button.	X			•
		o The previously selected control is deselected.	X			•
		o An empty or raised button indicates control is off; a filled or depressed button indicates it is on.	X			•
	5.3.3	**Pushbuttons/Command Buttons:**				
		o Consists of a name or icon within a rectangle or oval frame.	X			•
		o Select the control by positioning the pointer over it and pressing the Select button.	X			•
		o Releasing the Select button executes the action.	X			•
		o Default pushbutton should always be provided.	X			•
	5.3.4	**Text Fields:**				
		o Title or label appended to the field to identify the data to be entered.	X			
		o Text display scrolls horizontally if text entered longer than input areas.	X			
		o Text entered more than one line high, entry area should scroll vertically.	X			
		o Title describes what is to be entered and appears to the left or above the entry area.	X			
	5.4	**Button Definitions:** Standard vocabulary to be used in applications.	X			Page 13,14 15 CALS HCI
	5.5	**Window Colors/Patterns/Audio Signals:**				
		o Background patterns used to highlight group, clarify relationships, and add meaning.	X			Page 9,10 CALS HCI
		o Color not provided as the only means of visual distinction.	X			•
		o User-selectable color schemes.	X			Probably not permitted by secure operation styler.

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o Common color meanings used.				
		- red: stop, alarms, errors, danger, critical consequences	X			
		- yellow: warning, caution, approaching critical	X			
		- green: normal, safe, within normal range, proceed	X			
		- blue: cold, water, non-critical items	X			
		- gray: inactive, unavailable	X			
		o Critical messages use continuous audio tone and the color red until user responds. Non-critical messages use yellow and a short audio alert.		X		JCALS is not a tactical system. Also some terminal will be monochrome.
		o Colors used do not cause eye strain.	X			
		o Same color scheme for all windows of an application.	X			
		o Application window background is in enough contrast with foreground to stand out options or actions.	X			
		o Both color and sound should used for messages that require user acknowledgement.			X	
		o Critical messages displayed in red, and the audio alarm continues until the user responds.			X	
		o Non-critical messages displayed in yellow, accompanied by a short audio alert.			X	
		o Spectral extremes (e.g., red and green).	X			Not used
Dialog Boxes/ Pop-Up Windows	6.1	**Message Wording Guidelines:** Applies to dialog boxes, pop-up windows, message areas, and any other communications between the application and user.				
		o Abbreviations are only used when significantly shorter than full word.	X			
		o Abbreviations are meaningful, recognizable, and used consistently.	X			
		o Words that are not commonly abbreviated should not be abbreviated.	X			
		o Message lines end in full words rather than hyphenations.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o Messages are directly usable, requiring no further documentation or translation.	X			
		o Overly technical wording is avoided.	X			
		o Abrupt wording is avoided (e.g., INVALID, ILLEGAL, FATAL).	X			
		o Error messages focus on the procedure for correcting, not action that caused the error.	X			
		o Critical error messages are contained in caution/warning windows.	X			
		o Non-critical messages are displayed in the message area at the bottom of the application window.		X		
	6.2	**Work in Progress Window:**				
		o Feedback (for response time of 5 or less seconds) is in the form of a changed pointer shape or brief message within window.	X			
		o For response time exceeding JCALS requirement, a work in progress window is provided to indicate time-consuming operation and provide a means by which the operation can be canceled or aborted.	X			
	6.3	**Information Box:** Reserved for non-critical messages requiring acknowledgement by the user.				
		o Frequent informational messages are displayed in the window's message area.				Don't normally design a message area at the bottom of a window.
		o An information box can freeze application until user dismisses it.	X			
		o "Retry" button should be included if halted operation can be retried.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	6.4	**Caution/Warning Box:**				
		o Contains critical messages that warn the user.	X			Page 21, 22 CALS HCI
		o Usually contains Yes, No, and Cancel buttons.	X			Choice are usually worded as either yes and no or ok and cancel. Yes, No, and cancel is frequently ambiguous unless referring to a save operation.
		o Application is suspended until the user provides instructions on how to proceed.	X			
		o Message should be unambiguous question or statement.	X			
		o The default pushbutton should always be the least destructive.	X			
	6.5	**Menu Box:** Solicits data from users through a combination of controls.				
		o Menu box should be named in accordance with the menu item that created it.	X			Page 15, 16 CALS HCI
		o Cancel button included.	X			
		o If a default push button is designated, it should be the assumed desired action.	X			Page 14 CALS HCI
Common Features	7.1	**Date/Time Display:**				
		o Format is YYMMDD for date.	X			F.D JCALS (Page 5-20)
		o Format is HHMM{SS}Z for time.	X			F.D JCALS (Page 5-20)
		o Date/Time Group should be displayed as DDHHMMZ MMM YY.			X	
	7.2	**Latitude/Longitude Display:** Always given as two fields with optional labels (Lat, Long).				
		o Latitude - d{d}hOR dd{mm{ss}}h			X	
		o Longitude - D{D{D}}Hor DDD{MM{SS}}H			X	

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	7.3	**Help Features:**				
		o Context-sensitive help describes the purpose of the item and how to interact with the item.	X			F.D JCALS (Page 4-52)
		c Help for abbreviated label entry fields abbreviated or acronyms should include long, unabbreviated name and a definition.	X			F.D JCALS (Page 4-52)
		o Help is included as a menu title in window menu bar (control area).	X			F.D JCALS (Page 4-52)
		o The keyboard Help key and F1 function key are used to access help.	X			F.D JCALS (Page 4-52)
		o The title of a help window should reflect its contents.	X			F.D JCALS (Page 4-52)
		o Help is easily accessed and exited.	X			F.D JCALS (Page 4-52)
		o A single response is all that is required.	X			F.D JCALS (Page 4-52)
		o The help window is placed in the position that covers the least amount of information in the active application window.	X			F.D JCALS (Page 4-52)
	7.4	**User-Definable Parameters:**				
		o Users should be able to select map colors from a color palette.			X	
		o Users should not be allowed to change security banner colors.	X			
		o Users should be able to specify the printer destination.	X			
		o Mouse button function mappings -- users should be able to specify left-hand or right-hand button configurations.				Plan to, if possible
		o Experienced users may bypass help messages.	X			
		o Any changes are immediatelyreflected in a sample item displayed within the selection window.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	N/A	COMMENTS
	7.5	**Wild Card Characters:**				
		o '@' replaces any single alphabetic character (not case- sensitive).				SQL uses "%" to replace multiple characters and "_" to replace a single character.
		o '#' replaces any single numeric character (not case-sensitive).				
		o '?' replaces any single alphanumeric character (not case-sensitive).				
		o '*' replaces zero or more alphanumeric characters.				
Text Windows	8.1	**Data Field Labeling:**				
		o Displays should not be different from paper forms without justification.	X			
		o The layout of commonly used displays is consistent across all applications.	X			
		o Data field labels are easily distinguishable from the data itself.	X			
		o Columnar data should be distinctly separated (at least three spaces between columns) with column headings displayed above the data. One row of separation between the column heading and the data.	X			
		o Labels should be consistent throughout an application or set of applications.	X			
		o Field labels should be protected and transparent to keyboard control so that the cursor skips over them when tabbing or spacing.	X			
		o Dimensional units always associated with a field are displayed as part of the label and not required for entry by the user.	X			
	8.2	**Update Fields:**				
		o Updatable fields should be distinguished by underscores below the data field.	X			Highlighted
		o Cues distinguish optional from required fields and are consistent throughout application.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
		o The user should not need to right- or left-justify, or remove blanks from, the entered data in variable-length fields.	X			
		o The user should be able to enter data in familiar units.	X			
		o Application should perform any required conversions.	X			
		o Authorized personnel are able to selectively inhibit updatable fields in a multifield display.	X			
		o If colors or highlights are used, they should be consistent throughout the application.	X			
	8.3	**Text Cursor:**				
		o If the user clicks on a non-updatable field, the text cursor should not move.	X			
		o The text cursor should move between and within fields with the mouse or by using the Return/Entry key, the Tab key, or the arrow keys.	X			
		o The cursor should not obscure the character displayed in the position it designates.	X			
		o In insert mode, the text cursor should appear between the characters where the inserted text will be placed.	X			
		o In overwrite mode, the text cursor should highlight the character that will be replaced.	X			
Graphics Windows	9.1	**Data Display:** All maps should be north oriented, or the north direction should be annotated.			X	
	9.2	**Item Selection:** Guidelines for item selection on a map graphics screen.				
		o The cursor should include a point designation feature (e.g., cross-hairs or a v-shaped symbol).			X	
		o The user is able to select a single item within a densely packed group. When selected, the item should be highlighted.			X	
	9.3	**Interaction with Data/Items:** Functions are available through menus to permit the user to make measurements, perform analysis, and control the appearance.	X			

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	9.3.1	**Zoom-In:** Permits the user to magnify a portion of the graphics canvas.				
		o Includes reference display that indicates relative position of the area viewed within the original canvas.	X			F.D JCALS (Page 3-7)
	9.3.2	**Zoom-Out:** Rescales the display by permitting the user to return to the previous zoom level and position.	X			F.D JCALS (Page 3-7)
	9.3.3	**Full Zoom-Out:** Displays the lowest scale map.	X			Graphics
	9.3.4	**Distance/Azimuth:**				
		o Calculates the distance (range) and azimuth (bearing) between any two selectable points or symbols.			X	
		o Distance is presented in selectable units.			X	
		o Azimuth is displayed in degrees from true north.			X	
	9.3.5	**Determine Position:** Calculates the position of the point identified by a starting latitude and longitude, distance (in nautical miles), and azimuth.				
		o Answer provided textually.			X	
		o Coordinates presented in a selectable coordinate system.			X	
	9.3.6	**Clear Selection:** Deselects a selected graphics item.	X			
	9.3.7	**Current Selection Location:** Returns the geographic coordinates of the selected graphics item.			X	
	9.3.8	**Legend:** Opens/closes a panel that displays the symbols and corresponding textual titles available for an application.	X			
	9.3.9	**Map Overlay Editor:** Activates/deactivates a map overlay editor application.			X	
	9.3.10	**Overlay Options:**				
		o Capable of displaying a list of available overlays, distinguishing between visible and invisible overlays.	X			
		o Possible overlays include boundary lines, oceans, rivers, grids, masses, railways, and user-generated overlays.			X	

CATEGORY	DOD HCI S/G SECTION NO.	REQUIREMENT	YES	NO	NA	COMMENTS
	9.3.11	**Graphics Symbols, Line Types, and Colors:** Colors, symbols, line size/quality,and fonts should be consistent throughout a given system.				
		o Whenever possible, display symbology should conform with publishod standards (e.g., Army field manual 101-5-1, NATO standardization Agreement 2019, or DIA standard militarygraphics manual).	X			
		o Each system should be able to use a commercial graphics editor to accommodate the creation display of system-unique features and symbols.	X			
	9.3.12	**Area Bounding Boxes:** Pairs of coordinates defining a rectangular area in terms of latitude and longitude.				
		o Should be used when displaying maps.			X	
		o Displays the bounding coordinates for the geographic area being shown.			X	